THE FAR EASTERN REVIEW

上海仁記路拾六號

遠東時報

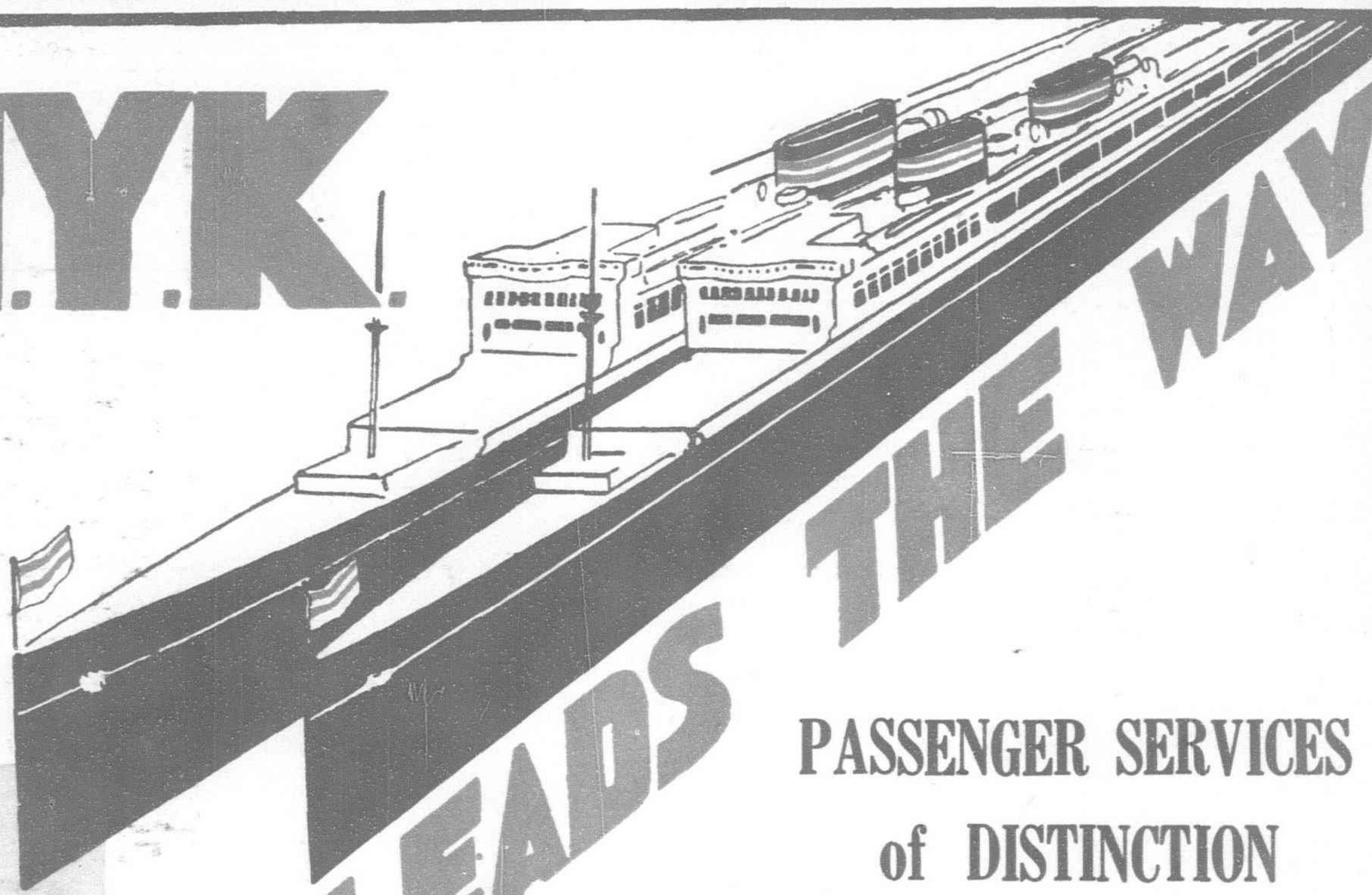
ENGINEERING

FINANCE COMMERCE

ASIATIC MARINE REVIEW

Vol. XXVI | AUGUST, 1930 | No. 8

N.Y.K.



LEADS THE WAY

PASSENGER SERVICES of DISTINCTION from THE ORIENT

To CALIFORNIA via HONOLULU, Fortnightly.
Three New Giant Motor-ships and Two Popular Passenger Steamers.

To SEATTLE and VICTORIA, Fortnightly.
Three New Splendid Cabin Motor-ships and also Medium-sized Cabin Steamers, the *Yokohama Maru* and the *Shidzuoka Maru.*

To PERU and CHILE via CALIFORNIA and MEXICO.
New Elite Passenger Motor-ship and Four Excellent Steamers, Monthly Sailings.

To BRAZIL and ARGENTINE via SOUTH AFRICAN PORTS.
Six Comfortable, Steady Steamers, Monthly Sailings.

To MARSEILLES and LONDON via SUEZ, Fortnightly.
Two New Passenger Motor-ships and Eight Modern Passenger Steamers.

To AUSTRALIA via PHILIPPINES and CELEBES, Monthly. Service Vastly Improved by Commission of Three Faster Vessels.

To BOMBAY via SINGAPORE, Monthly.
Three Medium-sized, Well-equipped Steamers.

CHINA-JAPAN RAPID EXPRESS SERVICE, Every 4 Days.
S.S. *Nagasaki Maru* and S.S. *Shanghai Maru.*

Full Particulars Obtainable at the Company's Offices and Agencies Located at all Important Cities and Ports Throughout the World.

N.Y.K., General Passenger Agents for Cunard Line

N. Y. K. LINE

Offices in China:

Shanghai, 31 The Bund
Hongkong, 8 Connaught Road

and also at:

Hankow, Canton, Dairen,
Tsingtao, Tientsin

The Far Eastern Review

ENGINEERING FINANCE COMMERCE

VOL. XXVI SHANGHAI, AUGUST, 1930 No. 8

Protection at Last!

AMERICANS in China have nothing further to fear. According to Reuter, Dr. C. C. Wu, the Chinese Minister to Washington has wired Nanking that, "*he has officially informed the United States Government that the Nationalist Government will assume full responsibility for the protection of the lives and properties of Americans in China.*"

The American regiment at Tientsin can now go home; the Yangtze Patrol can be scrapped; the Pacific Fleet now in Chinese waters can steam away to its base at Manila and the Marines at Shanghai transported to Haiti, Santo Domingo, Nicaragua or some other bandit-infested Bannana Republic. Americans owe a debt of deep gratitude to Nanking for this pledge of protection. There is nothing that should now interfere with the immediate acceptance of Dr. Wang's proclamation that extraterritoriality ceased on January First, 1930. The opposition of American citizens, residing in China, to an immediate compliance with China's abolition of extraterritoriality has been based on the fear that Nanking was as yet powerless to enforce law and order and protect American lives and properties anywhere in China—where our gunboats could not reach. Dr. Wu's assurance changes all this. Now that Washington has been officially informed that these fears are groundless, there is no good reason why there should be any further hesitation in recognizing Nanking's full jurisdiction over American residents in China.

It is natural to assume that Dr. Wu did not take the grave responsibility of giving this guarantee on his own initiative. He simply transmitted to the State Department the cabled instructions of his government. What we cannot understand is why the same guarantee was not communicated to London and Tokyo. Surely, if Nanking assumes full responsibility for the protection of American lives and properties it must also fulfill its obligations to the British and Japanese. Why then this silence on the part of Dr. Sze or the Chinese representative at Tokyo? Is it possible that the British and Japanese are being discriminated against? What a relief it would be to Premier MacDonald if he could quieten British apprehensions over the safety of their nationals and investments in China by assuring the country that he is in receipt of an official guarantee that the Nationalist Government assumes full responsibility for their protection. How gladly would Baron Shidehara take advantage of such an opportunity to withdraw the Japanese warships from China, and leave the subjects of Nippon to the protection of the powerful government at Nanking; *especially those Japanese residing in Shantung*!

What a rebuke such a guarantee would be to those suspicious London editors who recently have been finding fault with their Government's attitude towards the abolition of extraterritoriality. Just before Parliament adjourned for the Summer recess, Mr. Dalton, the Under-Secretary for Foreign Affairs told the House that the Government had under consideration the proposals made by Sir Miles Lampson, providing for the modification of extraterritoriality and that he hoped soon to submit them to the Chinese Government. The *Daily Telegraph*—one of the most influential organs in England—characterized these negotiations "as being indecent in the face of the fact that under the existing Government, foreigners and their interests enjoy no protection except that which their own government is in a position to furnish them." It pointed out that "the Nanking Government at the present time stands in imminent danger of being swept out of existence by a rival clique and concludes by saying that the blunder of the premature recognition of an unestablished authority was bad enough, but the diplomatic farce now progressing is far worse."

The Sunday Times fully endorses the views of the *Telegraph* and adds "that it should be obvious that while China is reverting to chaos, it is not a time to discuss the giving up of the remaining British concessions or the extraterritorial rights of British residents in China."

It is obvious that these old-fashioned British editors are not accurately informed as to conditions in China. There may be a little unpleasantness between the Yen-Feng-Moscow combination and Nanking, but this is only the usual Chinese method of reaching an agreement on political questions. These civil wars are merely the Chinese method of conducting their elections. A few hundred thousand Chinese soldiers may be killed, cities destroyed, provinces devastated and the non-voting people plunged into misery, but this is the price the Chinese are quite willing to pay in order to be permitted to solve their problems in their own way. A few foreigners, who get in the way, may be killed, but after all, that is their own fault. There have been only 39 missionaries killed and 98 captured in the last five years, without counting the recent kidnapping of Miss Nettleton, a British missionary lady carried away by the Fukien bandits and held for $50,000 ransom. When the money was not forthcoming they cut off one of her fingers and sent it as a sample of further mutilations unless the money for her release was forthcoming immediately.

Just think of it! Only twelve Protestant and twenty-one Catholic missionaries martyred and fifty-nine Protestant and thirty-nine Catholics carried off for ransom in the past five years! There was once a fellow named Perdicarus who wandered off the highway in Morocco and was captured and held for ransom by Raisuli, the Riff bandit chief. Perdicarus was a Levantine who, in some way, obtained American citizenship. He did'nt really belong and probably had no legitimate business in Morocco anyhow, but the honor of America was at stake so the whole weight and power of our Government was exerted to obtain his release. "Perdicarus Alive or Raisuli Dead" was the ultimatum that a former President hurled at the Moroccan Government. It is so long ago, that we forget what became of Perdicarus. Anyhow we did'nt have to go to war with Morocco over him. But those days of forceful statesmanship are past.

We admit to being puzzled. Why should Nanking single out America for preferential treatment. Why were Great Britain and Japan discriminated against? Can it be that such an assurance communicated officially to these governments would be considered an effrontery under prevailing conditions! At this moment when the representative of a British missionary society is carrying $50,000 ransom money to the bandits of Fukien in order to obtain the release of Miss Nettleton, we can imagine Dr. Sze walking into the Foreign Office in London and officially informing the Secretary of State for Foreign Affairs that the Nationalist Government assumes full responsibility for the protection of British lives and properties in China! Of course, he would be politely received and ceremoniously bowed out, but every newspaper in the United Kingdom would interpret such a communication as a rank impertinence, if not a deliberate insult. While Americans are deeply grateful for Nanking's determination to protect them at all hazard, we would feel more secure if the same guarantee is communicated officially to Tokyo and London. For, somehow we cannot escape the conviction that this solicitude for Americans synchronizes

too closely with certain British preparations to provide their own protection and, that it is inspired by the fear that Washington may, under pressure of public opinion, depart from its established policy of non-intervention and join hands with other Powers to put an end to an intolerable situation. But Nanking need not worry. Washington will never officially participate in any joint international armed intervention that might violate China's sovereignty and integrity.

The rivers of China can run red with the blood of butchered peasants and city dwellers ; it can be transformed into one vast graveyard ; its roads can be paved with the skeletons of famine victims ; it can become the center of World Revolution, menacing the whole fabric of Western Civilization and the stability of Japan, but America will never swerve from her traditional policy to uphold and respect the sovereignty of China.

Outside of Shanghai, Americans have very little at stake. Our total investments, including the Shanghai Power Plant is only a little over $200,000,000 and over half of that is under the protection of the guns of our fleet or the Marine Guard at Shanghai. The British stake is about $1,750,000,000 (gold) and the Japanese, $1,400,000,000 (gold). It would be much cheaper to evacuate all American citizens in China than to send troops to protect them. America has no concessions in China. Our Government has had too much respect for China's sovereignty to violate it in this imperialistic manner. But we have no scruples about residing, owning property and doing business in the other fellow's preserves and enjoying his police protection. No, China need not be alarmed. It did not require Nanking's official pledge of security to stave off the menace of joint international intervention or to keep America from taking part in any such imperialistic adventure. As far as America is concerned, the Chinese can go the limit in exercising their sovereign rights to carry on their elections in their own peculiar fashion of exterminating the voters of the other side.

What a relief it is to Americans residing in Hankow, Changsha and other cities in the communist-infested provinces of the Yangtze Valley, in Fukien and South China, in Shantung, North China and Manchuria, to learn that henceforth they are under the strong-armed protection of the Nationalist Government at Nanking! And yet, as this is written in the beach hotel at Tsingtao, we look across the bay and see the Stars and Stripes flopping lazily in the summer breeze from the stern of the Flagship of the American Pacific Fleet, with an ugly looking aeroplane carrier and some destroyers beyond and still further in the distance around the point, where we cannot see it, we know that there is anchored a business-like Japanese cruiser whose guns command the land approach to the port. We know the Japanese war-ship can blow to pieces any army that attempts to enter the city from that direction, and somehow, we are comforted. We know that Tsingtao is a hot-bed of Communism and labor troubles, the stronghold of Left Wing Kuomintang agitators determined to ruin Japanese investments and industrial establishments in this city. Given the opportunity, the communists will seize the port and city. There are probably something like 14,000 Japanese subjects residing in Tsingtao and at the moment probably a few hundred Americans with their wives and kiddies summering at the beach, who feel a sense of security in the presence of these war-ships. And, despite Nanking's guarantee, the departure of the Flagship *Pittsburg* will be the signal for an exodus of Americans from this one spot in China (outside of Shanghai) where real protection is assured. The Americans will go, but the Japanese will remain ; as safe as though they were living in Kyoto. Nanking may officially inform Tokyo that it will be fully responsible for the lives and properties of these Japanese, but it is a safe bet that the Gaimusho will take no chances. The business-looking Japanese cruiser will stick to the anchorage that constitutes the one guarantee that the city will not be overrun by the disheartened armies now engaged in the prolonged indecisive battle not forty miles away.—G.B.R.

MODELS!

For many years, the feudality of Shensi has been referred to as "The Model Province" and its despot, as "The Model Governor." It's one advantage over the other feudal areas of China was due to the fact that its overlord, adhering to the time honored principles of the Chinese art of warfare, is perhaps the greatest tactician, strategist and military genius that modern China has produced. By bluff, bribery, chicanery, compromise, double-crossing, straddling and sitting on a fence, the War-Lord of Taiyuanfu was able for nearly twenty years to play his fellow despots against each other, and keep his preserves free from the innumerable wars of conquest that have impoverished, desolated and ruined the rest of China. Freedom from warfare means comparative prosperity, increased sources of revenue, new taxes and capital levies ; ready cash to purchase the alliance of free-lance condottiere and pay the conscript armies who maintain the stupid people in submissive contentment with their enslaved lot. It brings in the funds to equip huge arsenals (the "Model Province" enjoys the distinction of possessing one of the largest and most modern munitions factories in China) and after paying out bribes, subventions, upkeep of the army, maintenance of arsenals, purchase of imported aeroplanes and war-material ; additions to the harem and the personal fortune of the Tyrant, a little money is available for building military highways and purchasing mechanical transport for the armies. As a matter of fact, the roads are built either by the military or forced labor and cost practically nothing. The orders that flow in to the representatives of foreign automobile manufacturers for chassis, trucks and buses are hailed abroad as evidences of China's progressiveness. Yes, Shensi is a Model Province, a faithful imitation of that grim type of perfection that transformed pre-war Europe into an armed camp ; an efficiency that has brought its inevitable consequences.

The same masterful ingenuity of squeezing the last copper cash in taxes from the pockets of an impoverished and despairing people and seizing their food crops and seed grain to feed the locust armies of the Tyrant of Shensi, has signed the death warrant of nearly three million helpless people. It is estimated that nearly 20 per cent. of the land that should have been planted to grain in the famine stricken areas of Shensi has been sown with poppy in order that the more valuable crop could be handed over to the War-Lord in lieu of taxes and exchanged for ready money to pay for his munitions. Feng Yu-hsiang, like his colleague in Taiyuanfu, is also a Model, but we must go back to Attila or Genghis Khan to find his prototype in ruthlessness. Nothing so faithfully portrays the "Tyrant of Shensi," as the celebrated painting "The Conquerors." In that hard-visaged host led by Napoleon, Ceaser, Alexander and other vandal warriors marching to victory over the piled-up corpses of their victims, there is a place in the vanguard for the War-Lord of Shensi, holding an execution sword in one hand and a prayer book in the other, leading his rabble followers to battle to the blaring strains of "Onward Christian Soldiers!" Feng's conquering armies are tramping out of desolated Shensi over a highway paved high with the skeletons of three million helpless victims starved to death in order that the Conqueror and his cohorts might survive. The Christian Powers of the world look on with silent indifference. They may not intervene or interfere with this paragon of virtue, the erstwhile Hero of the Missionaries and the Stool Pigeon of Moscow. Shensi stands as a Model of what can be accomplished by a Despot whose first and only concern is the maintenance of his armed forces, his one claim to power, position and prestige.

And yet, in fairness to Feng, it must be admitted that he stands alone, head and shoulders above his fellow Tyrants in many qualities that command respect. Feng is a Model of sobriety, a one-woman man, unostentatious, frugal, abstemious and a rigid disciplinarian. Dressed like his own soldiers, eating their simple fare and riding around in the driver's seat of a munitions truck, he makes a sharp contrast to the beribboned gaudy and immaculately tailored staffs of other War-Lords who pass their time banquetting and joy-riding in luxurious high-powered limousines.

Feng, at least, practices what he preaches. In many respects he is Model of what a commander should be, an example that could be followed with profit by other War-Lords in China.

Two years ago, immediately after the successful Nationalist-drive on Peking, and the establishment of their government in Nanking, the southern province of Kwangsi, enjoying the huge revenues derived from the transit tax on opium transported overland from Yunnan to Canton, drafted a grand scheme of road construction and dispatched agents to Detroit to purchase a few thousand chassis, buses and trucks, Kwangsi announced that it would show the rest of China how to do things on a big scale and proclaimed itself the "Model Province." Something evidently went wrong with the machinery, for we hear no more from its Publicity Bureau of the great things to be accomplished. The thousand or more buses and trucks that were to have plied their traffic on the roads of Kwangsi, are still in Detroit. The funds that were to have transformed this backward province into a model of efficiency have been devoted to waging war on the Central Government and in raiding and invading the territories of neighboring satraps.

It was only a short time ago, that Tang Shao-yi, the Elder Statesman of China, petitioned the Nationalist Government to be allowed to retire to his native district in Kwangtung Province and reorganize its administration along lines that would make it a model for the rest of the country. From his long experience as a Chinese official diplomat and statesman, Mr. Tang realized that China can be saved only through honesty in administration and in the collection and remission of taxes to the provincial and central governments. He knew that the revenues of his own native district, if honestly collected, could be more than doubled.

Something like Tls. 3,000,000 a year is contributed in taxes by this district to the National treasury and Mr. Tang is certain that this can be increased to $10,000,000 by honest administration. In this, he is probably correct, as from time immemorial only about twenty-five per cent. of the revenues collected throughout China has reached the central treasury. The district is reputed to be the richest in China. Many retired merchants who have made their fortunes overseas, reside there. It is also the ancestral home of Dr. Sun Yat-sen and the district has been renamed "Changshan" in honor of China's Great Leader. Tangchiahuan, (the ancestral home of the Tang Family) a coastal village connected by good roads with Macao and Canton, and enjoying a depth of water in the harbor sufficient for the entrance of the largest ocean liners, has been declared a free port for a period of sixty years. It is to be known as the Chungshan Port and will be developed under a program costing many millions. Mr. Tang intends to devote the rest of his life in making Chungshan, not only The Model District of China but the commercial center of the South and a world port rivalling Hongkong. Mr. Tang, however, labors under no illusions about the difficulties surrounding his task, as he stated on his arrival in Hongkong that his first step would be suppression of banditry and piracy in the district.

What a commentary on a scheme embracing such wonderful possibilities and which deserves every sympathy and support from all foreign interests. For although the port has been deliberately designed to deprive Hongkong of its supremacy, it will be many long years before the Chinese can develop the port to the point where it will compel a change in established world trade routes which now center at Hongkong. Chungshan undoubtedly constitutes a potential menace to Hongkong, but the day is long since, past, when any Power can advance any reasonable objection to China's legitimate aspiration to control her own deep-water trade outlets free from foreign jurisdiction or interference. The mere fact that Nanking has actually made the first step in such an important development scheme, at a time when all its resources are required to maintain itself in power, is a testimonial to a spirit of progressiveness that found no place in the program of any of the Northern military régime.

Tang Shao-yi, if given the opportunity, authority and support, will create a Model District that will serve to educate other prefectural and municipal governments in the fundamentals of administrative integrity and efficiency, without which the future of China is hopeless. As long, however, as China has to support over two million armed men, eating up eighty-five per cent. of the revenues of the country without including the local levies, sur-taxes, contributions and confiscation of food, stores and other military requirements it will be difficult to establish a Model Administration in any district where the military can enforce their will.

If the transformation of Chungshan into a Model District can be carried out, and the example extended to other districts, Tang Shao-yi will have given an impetus to the one force that will save China and eventually elevate her into a real world power. His experiment will be watched with great interest.

Now comes Chekiang and lays claim to being the Model Province. Chekiang will show the rest of China how to do things in a big way. It does not seem to make any difference that the southern part of the province is raided by Communist bands operating from Fukien or that its western borders are exposed to the invasion of the same ruthless and destructive forces working eastwards through Kiangsi. Chekiang enjoys the temporary distinction of being the home province of the Generalissimo of the Nationalist armies and other prominent leaders of the Nanking Government. If the wave of Communism now sweeping over the Yangtze Valley can be checked and the Nanking Government survives the present struggle, Chekiang will assume the leadership in implanting modern improvements. If, however, the Nationalist régime goes under, the province will revert to its old status as the private preserve of some military despot who will side-track all expenditures for public works and squeeze the people dry to provide the funds to maintain himself in power.

When the Chekiang scheme of public improvements was drafted, the outlook was particularly bright for the successful carrying out of the program, but the sudden outbreak of another devastating civil war and the financial necessities of the Nanking Government, hitherto met by advances from the Chekiang banking group, will probably consume all the available assets and ready cash of this strong financial combination and force a suspension of development work.

Although the Chekiang program might be fairly criticized because it creates a governmental monopoly of public utilities, the plan to electrify the whole province from one central station in Hangchow has much to commend it. The operation of one large modern equipped steam power plant in the provincial capital furnishing light and power to several cities and smaller towns, with its substations, tramways, irrigation, drainage and industrial consumers, will create the first super-power system in China under purely Chinese control. The Japanese have hooked up their various Manchurian plants and developed the first complete power system in the country. The Shanghai Power Company, if not restricted by the new laws creating a government monopoly of electric light and power plants could also develop another super-power system supplying the cities and towns in Kiangsu Province. This being out of the question for the moment, the Chekiang program is the one bright spot in the development of China along these lines, as its success is bound to be followed by similar installations in other Chinese centers, creating a market for power specialties that can be supplied only by the best foreign engineering firms.

It will be recalled that The League of Nations Health Section has entered into an arrangement with the Chinese Government to improve the sanitation and public health service of its cities and in compliance with this program, the province of Chekiang was to be made the Model for the rest of the country. This program naturally calls for many new water-supply systems, sewage disposal plants and other installations creating a market for foreign engineering specialties. Taken in connection with the Construction Program of the Chekiang Government as outlined in the article in this issue of *The Far Eastern Review*, there was every reason to believe that in due course, Chekiang would make good its claim to the title of "Model Province."—G.B.R.

Claude Neon Daylight Signs !

By the first of the year, the Claude Neon Laboratories in New York expect to complete lights and accessories for the production of brilliant natural colors in daylight.

These will be low voltage lights, and the delay has been occasioned, it is said, by difficulties cropping up in the application of this to the smaller units.

The reproduction of natural colors, in augmented brilliance, will mark another achievement of more than ordinary consequence.

American Investments in China

THE last month has witnessed the signing of two important agreements which materially increase American investments and interests in China. One contract, entered into between the Curtiss American Aviation Company and the Ministry of Communications for the formation of the China National Aviation Corporation, is a Sino-American partnership in which the Chinese Government holds the controlling interest, while the other, providing for the sale of the franchise and property of the Shanghai Mutual Telephone Co., Ltd., to the International Telephone and Telegraph Company, comes into sharp conflict with China's ideas of sovereignty over the foreign settlements and concessions not yet surrendered to her jurisdiction.

The terms of the aviation contract, made public on August 1, provide for the organization of a limited company with a capital of $10,000,000 (Chinese currency) divided into 10,000 shares, of which 5,500 are to be held by the Chinese Ministry of Communications. The Corporation will operate three air-mail and passenger lines; 1. *Shanghai-Chengtu, via* Nanking, Kiukiang, Hankow, Ichang, Wanhsien and Chungking. 2. *Nanking-Peiping, via* Hsuchow, Tsinan and Tientsin. 3. *Shanghai-Canton, via* Ningpo, Wenchow, Amoy and Swatow.

The contract is to remain in force for ten years when it may be extended for another five years by mutual agreement. In the same way that the telephone sale has been declared illegal by the Nationalist Government, the Northern Government at Peking has served notice that the aviation contract will not be recognized. Both transactions are typical of the difficulties attached to doing business with the Chinese Government and direct attention to the absolute necessity of keeping strictly within limits that will permit the State Department to extend diplomatic support in case of trouble. The aviation contract is obviously contingent upon the stability of the present régime at Nanking and its ability within three years to consolidate its rule over the whole country. Article V, of the contract, after specifying the three lines above mentioned, states that the Shanghai-Chengtu line will be started first and should its results prove satisfactory, the second and third lines will be immediately started, but in the event that a start cannot be made within three years, the corporation will lose the privilege unless such failure is due to *force majeure*, a diplomatic way of admitting Nanking's inability to enforce its authority in the north and south and allowing itself three years in which to make good. The assumption that the Curtiss Aviation group is incapable of starting these two lines within three years, is such a reflection on its standing that it would almost invalidate the contract, so the conclusion to be drawn from the clause is simply that Nanking has sought to give itself plenty of time in which to consolidate its rule.

The line into Szechuan is already being operated by the Ministry of Communications and has been incorporated into the service of the new company. Yet, after it leaves Hankow it enters territory controlled by semi-independent war-lords and bandit generals who may at any time reconsider their nominal allegiance to Nanking and hold out for a slice of the profits. The Nanking-Peiping line, *via* Hsuchow, Tsinan, and Tientsin, is so palpably an invasion of the Northern preserves, that only a complete victory in the present struggle will permit Nanking to carry through its program. It is noticeable that the coastal Shanghai-Canton line, perhaps the most profitable of the three, omits Foochow, the provincial capital of Fukien, as a port of call, another indication of the tenuous hold that Nanking has over this important province. This route has the advantage that amphibian planes can be employed and water landing made in comparitive security from bandit interference. Unless Nanking emerges completely victorious from the present struggle, American interests may have to face another fiasco. The Curtiss-American group are simply taking a chance with the recognized government of China, a fairly safe one at that, but nevertheless a gamble on its ability to pull through. There have been so many centracts entered into between Americans and the recognized governments of China, only to be set aside or cancelled by the next régime, that it is difficult to become enthusiastic or optimistic over any semi-official enterprise that becomes the legitimate prey of every new grouping of Chinese officials. It is to be hoped that Nanking will emerge from the present war, sufficiently strong to impose its authority over all the provinces covered by the lines of the contract, as otherwise, it is certain to undergo the same vicissitudes as the Siems Carey railway agreements, winding up by the Chinese having the advance money and the Americans a useless contract and a claim for damages.

In the sale of the telephone property and franchise, American investors have a somewhat different problem to face. Despite the opposition of the Chinese Government to its sale to a foreign company, the transaction is so well within the strict letter of the law that the American Government will be compelled to stand by the International Telephone and Telegraph Company's purchase. Adhering to its fixed policy to abolish private control of public utilities in favor of governmental ownership, the Nanking Government has strongly objected against the transfer of the Shanghai telephone property, declaring its intention and willingness to purchase the property itself, but at no time did it make any formal offer. It claimed that over sixty per cent. of the shares of this British company were owned by Chinese, but it is worthy of comment, that it could not influence these shareholders to vote against the transaction and stop the sale. If the Chinese Government was correctly informed as to the ownership of the shares, it is fair to deduce that a large percentage was held in trust by foreigners. On the other hand, the share books of the company do not support the contention of the Chinese Government, and the fact that the sale has gone through without any attempt on the part of the Chinese shareholders to assert their majority rights, would seem to be sufficient evidence on which to challenge the veracity of the official statement. Again, if the Chinese Government is accurate in its statement, its inability to influence the Chinese majority stockholders constitutes a challenge to its authority. If the Chinese shareholders could not be moved by appeals to their patriotism or nationalism in a matter like this, it must be construed as a lack of confidence on their part in the ability of their government to make good on its offers to purchase. Viewed from this angle, the transfer leaves Nanking in a very embarrassing position.

The telephone transaction has been carried out with a strict observance of the law and until such time as the International and French Settlements are surrendered to Chinese jurisdiction, there can be no question as to the validity of the sale. When that time arrives if the Chinese Government still insists that the sale was illegal it will have a case that will have to go to the Hague Court, with the certainty that it will lose and be compelled to pay the full value of the property and an indemnity for the loss of prospective profits for the unexpired term of its forty year franchise.

The Shanghai public is not so much interested in the financial and political aspects of the sale as it is in some reasonable service in return for its money. The old Shanghai Mutual Telephone Company, whether for lack of funds or other reasons, seemed incapable of bettering its service, so the sale of its property to any one of the three interests competing to acquire it, was hailed as a promise of much needed improvements. The public was not specially interested in the nationality of the successful bidder. All it wanted was results. The prolonged fight between the Ericsson, Automatic and Western Electric interests for control, of the telephone service and the entry of the Chinese Government into the field, with all the partisan propaganda and mud-slinging, made little impression upon the community at large.

There was every reason to believe that much of the bitterness engendered over the transaction arose from the disappointment of one of the unsuccessful bidders, who rather than see the franchise go to its competitor, encouraged the Chinese to oppose the sale. In this respect, the Shanghai fight is typical of the bitter competition going on in other parts of the world for the acquisition of telephone rights and concessions between rival American interests. Although both are controlled by American capital, they are international in character, with branch factories, subsidiaries and ramifications in many countries of the world. At times, it is difficult to understand just where American interests begin and end and the rivalry created makes it embarrassing for American diplomatic representatives to render assistance to one interest without being charged with partiality by the other. Both are manufacturers of the most up-to-date

(Continued on page 409)

Chekiang Development Program

EDITORIAL FOREWORD: In the June issue of *The Far Eastern Review* appeared an article on the "Construction Program of the Chekiang Electricity Bureau," outlining that part of the provincial development plan coming directly under the supervision of that bureau. The following brief summary of the other main features of this construction program will give a more comprehensive idea of what Chekiang is trying to accomplish on its own initiative and credit. In the editorial article entitled "Models" in this issue of this magazine, we have drawn some sharp comparisions between the spirit of progress that characterizes the policy of the Nationalist Government and the cold, calculating ambitions of the Northern War-Lords. At a time when so much destructive energy is being displayed throughout all parts of China, it is refreshing to be able to comment with approval on such commendable constructive programs such as are being carried out by the Provincial Government of Chekiang and the even more important administrative experiment in the Chungshan district of Kuangtung, directed by China's veteran statesman, Mr. Tang Shao-yi. These two programs typify what Nanking has been trying to accomplish on a larger scale by devising huge schemes for the development of railways, highways, port works, city planning and other public improvements, whose execution has been postponed owing to the fact that the funds have all been swallowed up in purchasing the allegiance of Northern War-Lords, subsidizing a lot of bandit chiefs and carrying on wars to maintain its authority. Nanking can be fairly criticized for concentrating on these enormous development schemes and appropriating funds for their execution at a time when the dictates of humanity call for the marshalling of all its resources to save the lives of its starving millions, but on the other hand, it is evidence of a will to develop the country along modern lines and provide work for the masses.

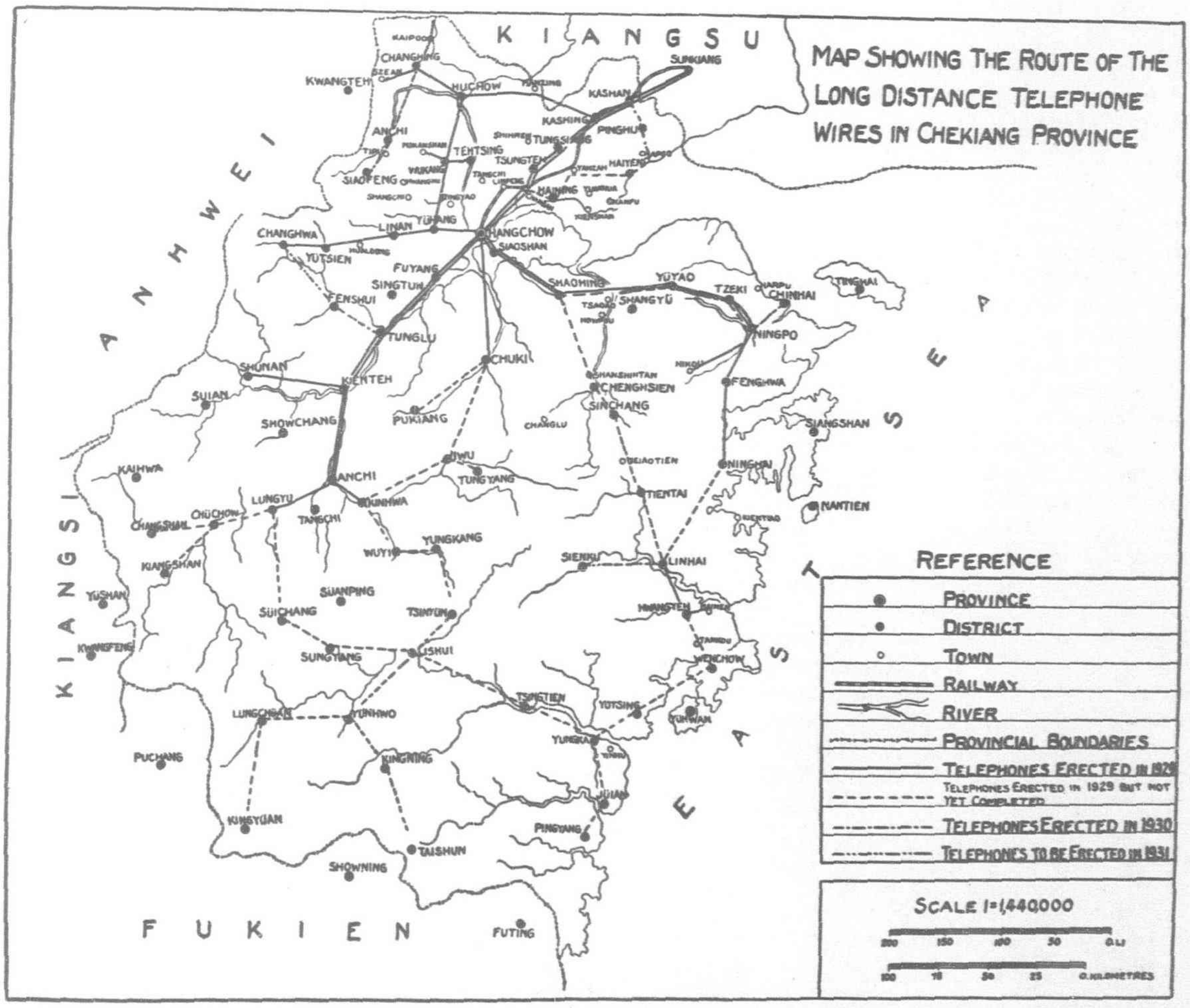
Although Chekiang's claim to the distinction of being the Model Province of China is perhaps premature, there is every indication that if internal political conditions do not cause a complete breakdown of its program, it will be entitled to this honor. The program, as outlined below, is an extremely modest one, calling only for the initial expenditure of ten million dollars silver, but even this small sum, honestly applied under proper engineering supervision, can do wonders in China. In addition to the provincial government program there are other interesting private railway projects being carried forward in Chekiang and then there is the Health and Sanitation program that the Chinese Government has agreed to start in collaboration with the Health Section of the League of Nations in Chekiang in order to make this province the Model for the rest of China.

The North accuses Nanking of having accomplished nothing in a constructive way but the Chekiang program is evidence of a spirit of provincial initiative and progressiveness under the rule of Nanking that could not be conceived and carried out by any province north of the Yangtze under the heel of the Pei-Yang militarists. It is true that Manchuria, under the absolute rule of Marshal Chang Tso-lin and his generals, carried into effect a remarkable railway and industrial development scheme, but the funds which made this possible were wrested from the people by compelling them to hand over their crops to an official combine who paid for them in nice, new, incontrovertible paper notes. The combine then sold the produce for hard cash. The Manchurian farmers accumulated trunk loads of worthless paper and their overlords pocketed the gold. Over $500,000,000 (silver) a year was obtained in this way from the soya bean crop alone. It is roughly estimated that Chang issued nearly seven billions of these notes over a period of four to five years and he must have received its equivalent in hard cash from the sale of the beans and other cereals. Had Nanking enjoyed the handling of the enormous sums raised by, Mukden, Kirin, Tsitsihar and Harbin, it would not only have established its rule over the whole country, but realized its most important construction schemes. Seven billion dollars in paper notes converted into silver, would have built 70,000 miles of railways, or let us say 20,000 miles of railways, all the port works and other public improvements conceived by Dr. Sun Yat-sen, liquidated all of China's indebtedness and still leave a billion for relieving poverty and destitution throughout China!

* * *

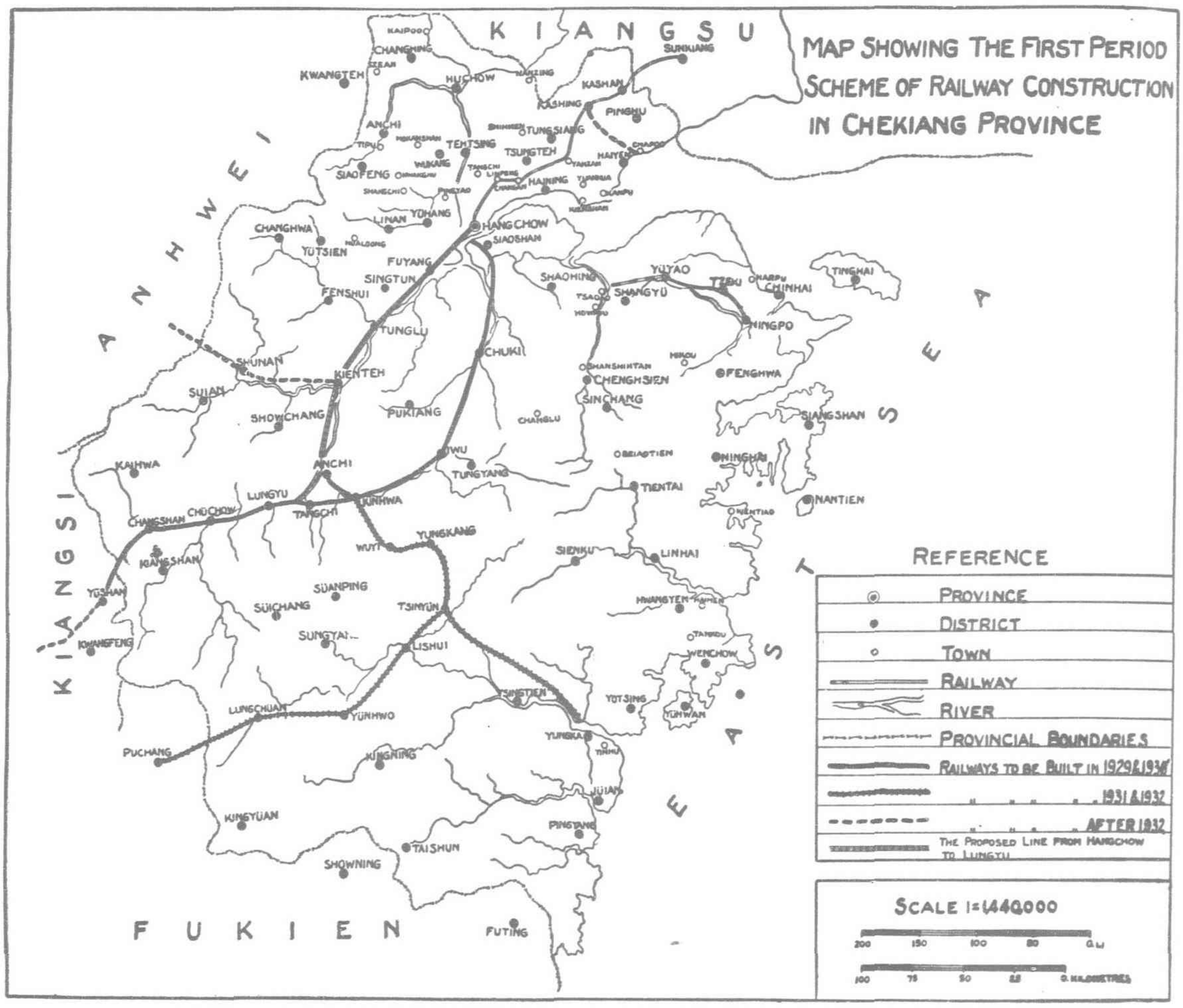
The Chekiang Program

The Chekiang Provincial Government has laid down an extensive program of development covering electric light and power, communications and river conservancy to be carried out over a five year period. Construction bonds to the amount of $10,000,000 have been authorized and issued at 98 drawing 8 per cent. interest, payable semi-annually. They are to be retired in eighteen install-

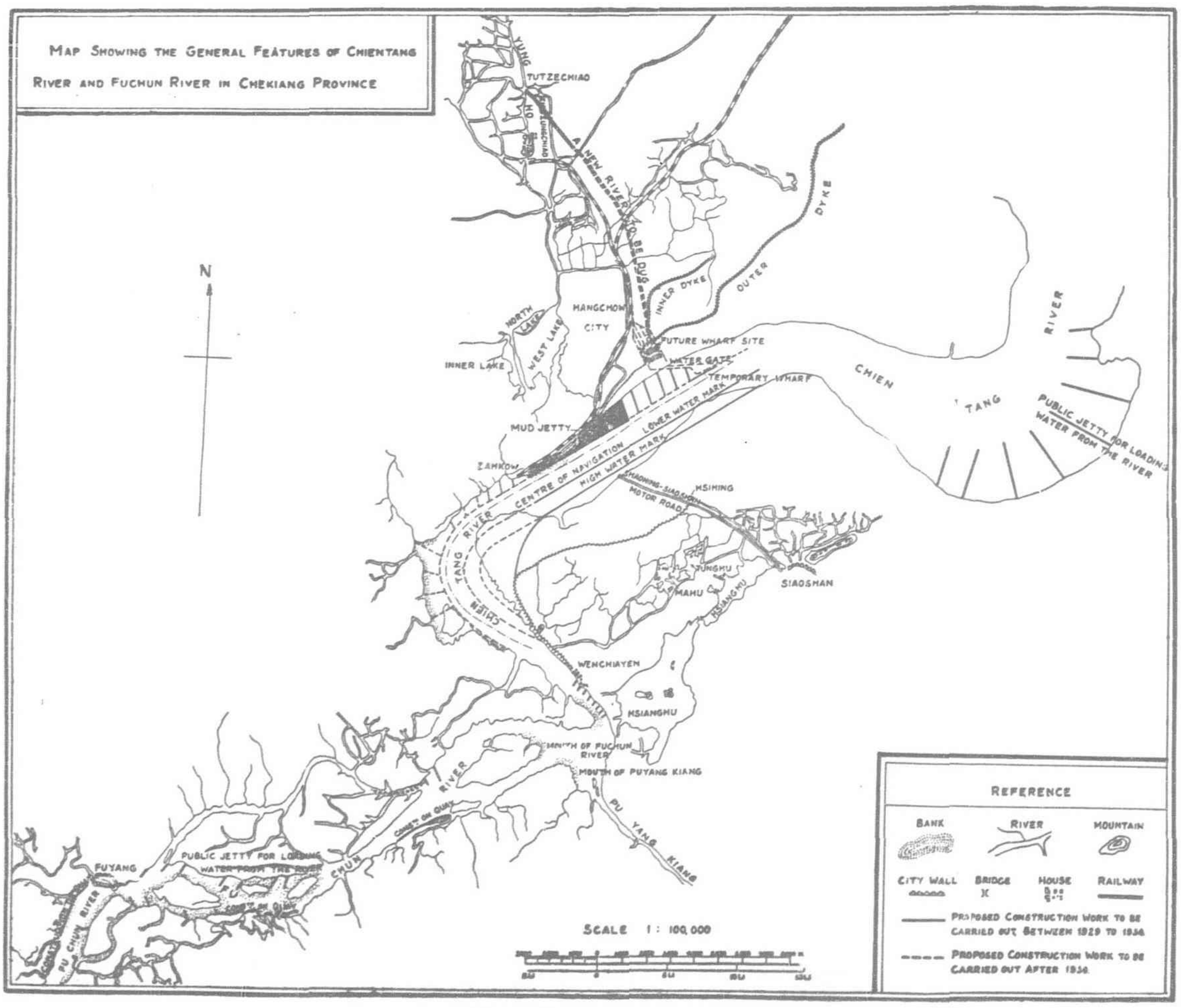


Long Distance Telephone

ments at six months intervals during a period of nine years and secured by the revenue from a surtax on land, from which $1,600,000 per annum is set aside for the service of the bonds. Of the proceeds of this issue, $1,980,000 have been allocated to the Provincial Electricity Bureau to carry forward its program of extension. The Electricity Bureau as the first step took over the Dah Yoh Lee Electricity Works of Hangchow. The five year program involves the construction of a 15,000 kw. initial unit for a generating station at Hangchow, the reconstruction of the present electrical distribution system in Hangchow and the construction of transmission lines to Yuhang, Kashing and Huchow. The construction of irrigation and drainage plants and the addition of a second 15,000 kw. unit to the Hangchow plant and an electric tramway system for the city of Hangchow are expected to be started during this period. The plan also contemplates the erection of an electric testing laboratory. The Chekiang Commission of Construction is aiming electrifying the whole province and the first central station of a super-power steam system will be the one at Hangchow, the provincial capital.



Railway Plan



River Improvement

Communications

The Commission has also drawn up an elaborate program for railway and highway building, long distance telephones and a radio system. In 1929, there were only 270 kilometers of highways in the province. The report for the current year shows 600 kilometers, and it is expected that by next year there will be 1,100 kilometers. The Commission emphasizes that more consideration must be paid to making the existing roads pay by encouraging and increasing the traffic and that the profit from their operation be set aside as a special fund for further road construction. The number of buses and trucks in Chekiang in 1929 was 95, which increased to 110 in 1930. The program calls for the purchase of an additional 600 trucks and buses to be ready for service in 1931.

Railway communication in Chekiang is at present confined to the Shanghai-Hangchow-Ningpo Line with a total length of 189.57 kilometers. The construction program

provides for the completion of the three following additional provincial lines ;

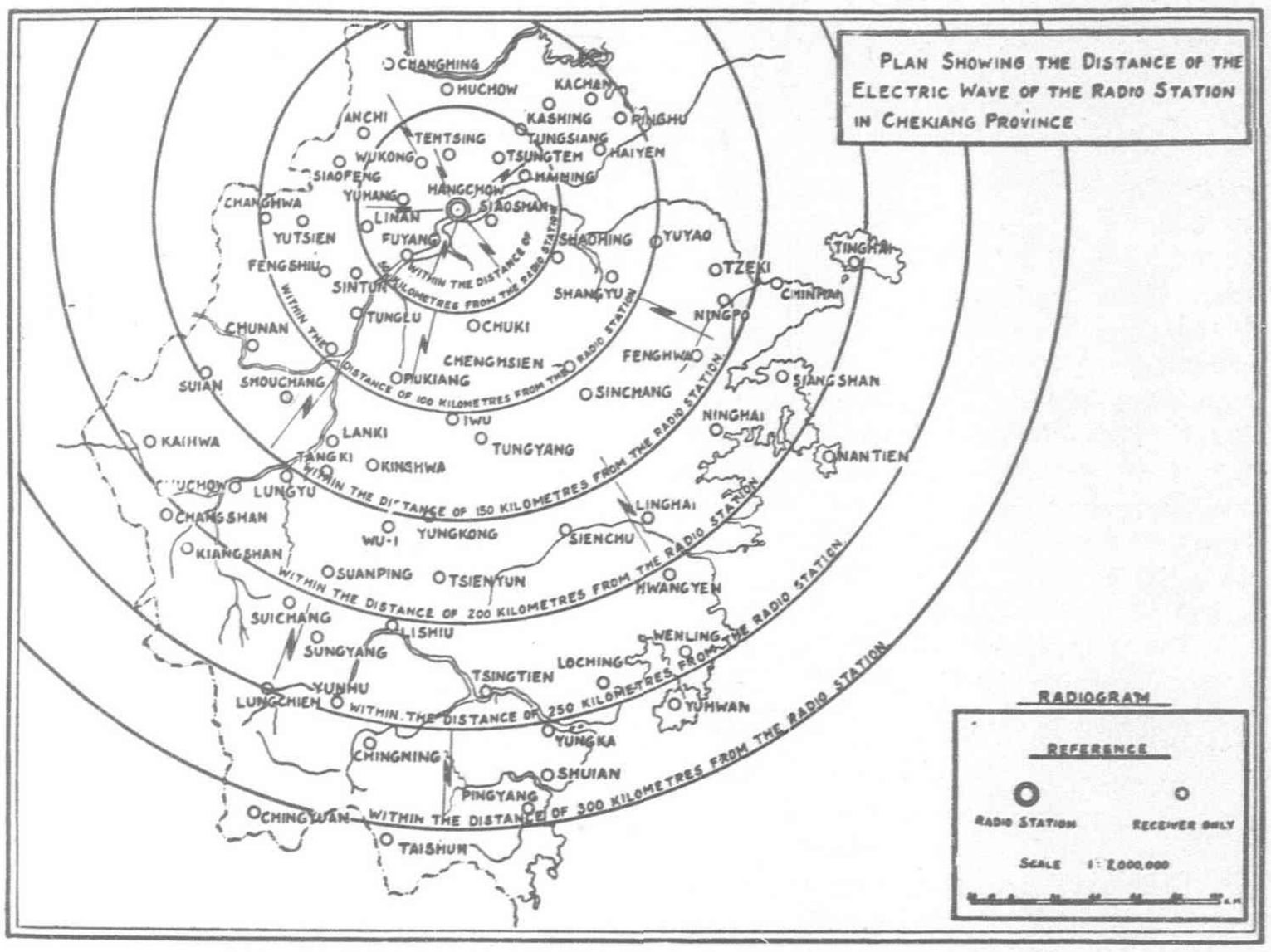
1. Siaoshan-Changshan Line, 315 kilometers.
2. Kinhwa-Yunkia Line, 180 kilometers.
3. Tsinyun-Puchen Line, 170 kilometers.

These lines will be connected with the Shanghai-Hangchow-Ningpo Railway and form the skeleton of the future provincial system. The total estimated cost of the above three lines is $23,700,000 silver, or approximately $60,000 (silver) per mile. (With exchange at its present level, these estimates will have to be doubled). Work is to be started this year and completed by the end of 1933.

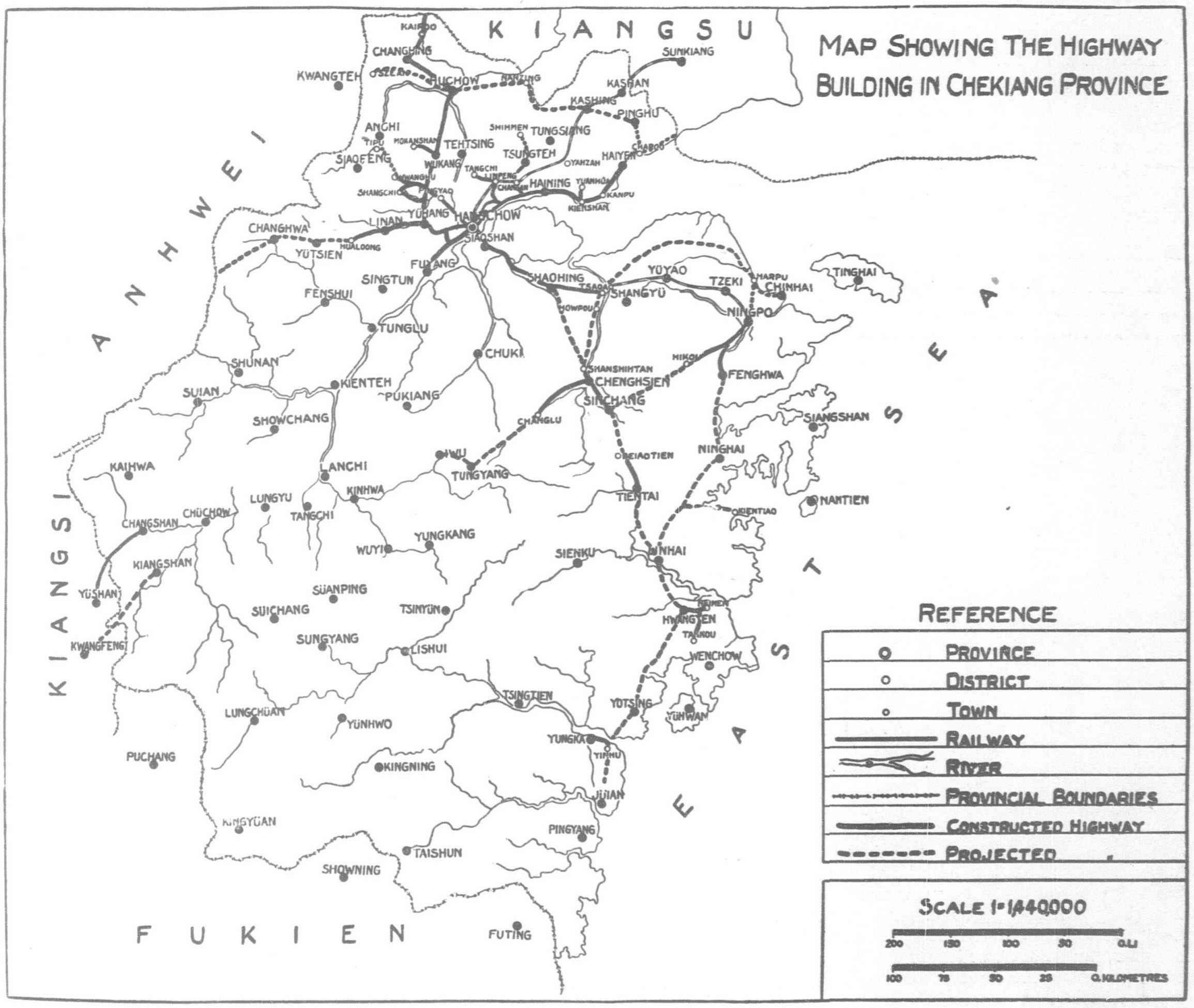
Telephones

The long distance telephone program is an ambitious one. Started in 1929, when completed, it will link together practically all the cities of the province. A systematic annual plan of construction is being followed. In 1929, thirteen long distance telephone lines were strung :

(Continued on page 414)



Radio



Highways

The High Cost of Living

THERE is a world wide interest in the standard of living maintained by the people of each country and various studies have been made to determine the status of each nation's population as to the amount of wages earned, the necessary expenditures for living and the ratio between the two amounts. A few surveys have been made in China, but they have been more in the nature of estimates than complete studies of the situation, due largely to the difficulty of obtaining statistics. The following table is compiled from various estimates and studies made anent the standard of living among the poorer classes of Shanghai by the Nantai Weekly Statistical Service, the Bureau of Social Affairs, and the Ministry of Industry, Commerce and Labor.

The following table gives the average monthly earnings of factory workers in Greater Shanghai for 1928, over a period of six months, the statistics being given for three months at a time.

MONTHLY EARNINGS

Industry	*Workers*	*Month*		
		July	*September*	*December*
Silk Reeling	Females	$14.61	$15.44	$15.60
	Children	8.37	8.70	10.19
Silk Weaving	Males	25.37	25.21	27.76
	Females	16.33	16.27	17.81
	Children	10.45	10.95	11.23
Paper	Males	21.01	21.47	20.88
	Females	8.94	8.70	9.58
	Children	11.60	9.54	8.96
Toilet Preparations ..	Males	18.35	18.20	18.75
	Females	12.07	12.02	12.97
	Children	9.41	9.41	12.42
Electrical Machines and Appliances	Males	22.70	22.92	25.45
	Females	22.03	18.25	15.52
	Children	11.57	11.53	13.33
Tobacco	Males	18.77	20.75	21.96
	Females	10.31	13.51	15.90
	Children	4.03	8.30	6.43
Tanning	Males	16.10	16.80	17.82
	Females	12.70	13.32	12.18
	Children	9.44	9.68	8.68

A summarizing of the above table shows that the average monthly earnings differ in the various industries as well as in the types of workers. To think of human beings having such small monthly earnings for livelihoods is appalling to westerners, who cannot live on so small a sum per week, and most earn almost that much per day. It is noticed also that each type of industry uses a particular type of worker, either male or female. In the silk reeling and cotton spinning the female workers are the most important ; at the same time, in paper and machinery manufacturing we find that males are the principal working class.

In general it was found that industrial workers could be divided into two classes, and our table gives representative groups from each class. The first group is comprised of those earning from $10—15 per month in the following industries : silk reeling, cotton spinning, wool weaving, tobacco factories. The second group is made up of those who receive $15—25 per month as earnings ; in the industries, cotton weaving, silk and cotton knitting, paper, candle and soap, match, paint and varnish, tanning, glass, enamel, toilet preparations, bleaching and dyeing, electrical machines, and appliances, foundry, cement and tiles, flour, oil and their by-products, sawing, egg and egg products, cold drinks and refrigerating, and cold drinks. There is a third group that has the munificent monthly earnings of $25—40 in the industries of silk weaving, machinery, shipbuilding, waterworks, electricity and printing. The reason for the higher wages in the third group is the longer period of training and apprenticeship and the greater skill required.

A few facts about individual factories should be noted in our review of the monthly earnings of industrial workers of Shanghai. In some cases where the individual class of workers as males, females or children and a very few members of that class of workers was entirely omitted. This was true for the male workers in the silk reeling industry and female or child workers in cement and tiles, glass, paint and varnish, and a few other industries. In the tobacco industry the figures were necessarily limited to Chinese firms as the British-American Tobacco Company failed to give the necessary data concerning its workers, as to the number employed, and amount of wages paid. The Commercial Press leads all other firms in the number of workers and in the amount of pay. The higher rates of this one concern raises the average for the entire industry.

There are seasonal fluctuations noticeable in the variation between the wages paid in July, three months later in September and again in three months in December. In general, the wages as a whole were higher from September to December than they were from July to September. The higher wages in the latter half of the period showed an average increase of about 10 per cent., in the textile groups. In the industries concerned with chemical products we find a very slight increase in tanning, and toilet preparations. In the group of machinery there was an average increase of 10 per cent. during the second half, with the highest average in December in electrical machines and appliances. In tobacco, the average was kept at a normal level until a sharp raise in October, November and December.

There are definite reasons for these fluctuations which will now be considered in detail. First, there is the reward and bonus contingent on the holiday season. Rewards are given to encourage the workers to work on holidays and to punch the time-clock for a full number of days each month. These rewards do not affect the average of pay as they are received monthly, as do the special rewards for the New Year, festival days or the bonus. In December rewards were given in the following industries, often, for the only time of the whole year : soap and candle making, machinery, electricity, flour and printing,

The second cause for fluctuation is the seasonal variation : (A) The hot weather in July, August and September lower the amount of work done by the piece workers and the number of days actually worked. (B) The quantity of work required each season varies depends on the demands of the market and also upon the seasonal supply of raw materials or the distribution of products. The textile workers work night shifts beginning in October due to the enormous supply of raw materials at that season, which raises the average wages due to overtime earned.

A third cause of the variation in wages earned is due to time work and piece work. In silk reeling and weaving, chemical products and food products, machinery and electricity the fluctuation was very slight as time workers are largely employed. The amount of rewards and extra pay depend on the worker's industriousness, but at that the variation over the period of three months is slight. The piece workers in the silk, weaving, match making and tobacco industries receive pay according to their output and the variation is somewhat greater here, as often these workers miss more days per month than do the time workers.

Some of the other reasons for the change in the average monthly earnings of industrial workers of Shanghai were : the boycott on Japanese goods since May, 1928. The Japanese factories paid very low wages during the period of boycotting and the tanning industry suffered severely ; (B) Labor strikes and disputes did not affect average monthly earnings very much as only a few of the mills were affected. A strike that extends to a whole industry as that of the silk filatures during June, 1928, have a very definite influence on the monthly average of wages. (C) The addition of representative factories that were large enough to affect the average of workers in industries such as sawing, tobacco, enamelling, and glass making.

Briefly, the average, obtained by the method of weighted arithmetic average, of the monthly earnings of a given industry represents the resultant of all those factors that have effected the earnings of a given type of workers in a month. The factors having a slight effect on the monthly average of earnings are : monthly rewards, number of days worked, and strikes in a few small mills. The important factors involving definite changes in the general average are : special rewards, demand, supply of raw materials, seasonal variations due to weather, suspension of work at beginning or end of period under observation, or causes that are social or political in nature.

It is impossible to think of these workers maintaining a high standard of living in comparison with western standards when the average wage is less than that received for a fourth the time used in work by a foreigner. Or, to put it in another way, the wages

received by industrial workers of Shanghai are a fourth of the minimum paid to foreign industrial workers in America or Germany. Not only is a desire for higher standards of living impossible according to western criteria, but how do these workers keep body and soul together at all is the logical question. A brief review of the expenditures of these workers will be given to show what they do with their infinitesimal salaries, or, rather wages.

It is necessary that a mere satisfaction of physical wants take up a disproportionate amount of earnings among the laboring classes. There can be very little left to be written under the heading of culture. The following table will deal with family and individual expenditures of workers in Shanghai :

CHINESE DOLLARS.

Year	Type	Food	Cloth	Rent	Fuel and Light	Miscellaneous	Total	No.
		$	$	$	$	$	$	
1926	Worker	15.06	3.94	5.02	19.93	9.32	35.85	1
1926	Unskilled Worker ..	10.00	1.00	1.50	1.50	1.00	15.00	2
1926	do. ..	13.50	2.00	2.00	1.50	2.00	21.00	3
1926	do. ..	11.10	2.13	2.78	1.92	3.42	21.34	4

Percentage Distribution for Family of Laborers.

	Food	Cloth	Rent	Fuel and Light	Miscellaneous	Total
No. 1	42.0%	11.0%	14.0%	7.0%	26.0%	100%
No. 2	66.6%	6.7%	10.0%	10.0%	6.7%	100%
No. 3	64.4%	9.5%	9.5%	7.1%	9.5%	100%
No. 4	52.0%	10.0%	13.0%	9.0%	16.0%	100%

TABLE OF PERSONAL EXPENDITURES OF WORKING CLASS.

Year	Type	Food	Cloth	Rent	Fuel and Light	Miscellaneous	Total	No.
		$	$	$	$	$	$	
1926	Skilled worker ..	7.32	2.31	3.09	0.57	5.97	19.26	1
1926	Unskilled worker ..	5.45	1.19	1.78	0.47	2.96	11.85	2

Percentage Distribution of Earnings of Worker.

	Food	Cloth	Rent	Fuel and Light	Miscellaneous	Total
No. 1	30.0%	12.0%	16.0%	3.0%	31.0%	100%
No. 2	46.0%	10.0%	15.0%	4.0%	28.0%	100%

The "miscellaneous" group includes whatever money is spent for entertainment or culture and in a few instances is it above 25 per cent. or a fourth of the monthly earnings. Statisticians in America say that the average worker in America or salaried person should not spend more than one-third of his earnings on his living. But in Shanghai, at least three-fourths of an industrial worker's wages must go for the physical necessities of life, the entire earnings being so low. In proportion to the wages paid the cost of living is too high, due partly to the higher standards required by foreigners in Shanghai, the higher standards more and more desired by the workers themselves, and the extremely high cost of food and rent, because of the sudden influx of industrial workers to the city from the rural districts causing resulting in a congested state of living conditions. General industrial prosperity is contingent on modern methods of mass production, economic adjustment of wages to coincide with industrial expansion and the increasing rise of cost of living and the development of a ready market, either internal or foreign for China's manufactured produce.

There are some interesting and pertinent facts regarding Shanghai industries in general that should be mentioned here. Out of the total amount of capital invested, foreign capital occupies more than 60 per cent. ($189,979,691) and Chinese capital a little less than 40 per cent., ($103,622,800.) In the textile industry, the most important modern industry in China, Chinese capital claims only 23 per cent. ($45,087,250.) the rest being foreign, ($152,676,800) In the industries grouped under "Daily Necessities" which are of paramount importance to the daily life of Chinese people, the foreign capital ($23,822,200) is almost equivalent to the Chinese, ($25,892,760.)

In regard to the number of industrial workers employed in each industry, the male worker has a percentage of 34, while female and child labor in Shanghai industries confirms the nation wide drift towards the factory system under which the wives and children often desert their homes for industrial work. The relative importance of the industries in Shanghai may be judged through a review of the amount of capital invested and the number of workers employed. That which employs the greatest amount of capital is the textile industry ($197,764,050.) next to which is the food industry ($49,714,960.) As to the number of workers employed, the textile industry also ranks first (170,532) and the food industry, second, (15,060).

In all, there are 1,781 factories in Shanghai with a total capital investment of $293,602,491. Of this invested capital $103,622,800 is Chinese and $189,979,691 is foreign owned. The industrial workers number, male, 74,725 ; female, 126,586 ; child workers, 20,135, or a total of 221,446 industrial workers. There is a capital investment of about $1,000 per capita worker in Shanghai industrial firms.

American Investments in China

(Continued from page 404).

automatic telephone apparatus. In this Shanghai transaction, it has been equally impossible to take sides in the fight. The conditions were fair and equitable and the decision finally arrived at must meet with the approval and full support of other American interests. The final acceptance of the tender of the International Telephone and Telegraph Company is a guarantee that Shanghai will have a telephone service unsurpassed by any other city in the world.

Under the terms of the contract, the telephone service of Shanghai will have 17,000 new automatic lines within eleven months, 22,000 within twelve months, 24,000 in fourteen months, 30,000 in eighteen months and 43,000 within twenty-four months. Negotiations having been concluded, the work of improvement and extension will now go forward in earnest under the local I.T. & T. organization.

It seems a pity that this important American undertaking starts its career in China under the handicap of official opposition and a refusal to recognize the legality of its title deeds and franchise. If the dispute cannot be amicably compounded it may eventually become a major diplomatic incident involving China's right to assert her rights by unilateral action. It must not be forgotten that China officially abrogated her treaties on January first last, and the time will come when Nanking will invite attention to this and stand firmly on the legality of this declaration.

Although the activities of the Shanghai Telephone Company are confined to the International and French Concessions, its usefulness is not complete until it provides a long-distance service in connection with the government controlled lines. If Nanking persists in refusing to co-operate, the Shanghai enterprise will be compelled to work within a water-tight compartment, which, although sufficiently large and important to made a substantial profit, falls far short of what a modern telephone service should be. For the I.T. & T. to establish a system of communications in China similar to those it so successfully operates in other countries, it must hook-up with the Chinese Government long-distance lines. It can be taken for granted that all kinds of pressure and arguments will be brought to bear upon Nanking by competitive interests in order to hold the field open. Nanking may do so, but in the end, the matter will have to be adjusted in the interests of the public. Non-co-operation works both ways. If the Chinese Government refuses to transmit messages from Shanghai over its long-distance lines, it loses that much out-going business and deprives itself of the revenues from out-port messages to Shanghai.

The outcome of the telephone incident will be followed with keen interest by all Americans concerned in the development of China. The failure of this enterprise through Chinese obstruction will have far-reaching effects on American investors. To add another fiasco to the already long list of impossible transactions, would be the height of folly on the part of Nanking. So far, every contract or concession entered into between former Chinese Governments and Americans have resulted in the Americans being gold-bricked and their government placed in an embarrassing diplomatic position unholding the principle of the Open Door. If Nanking entertains hopes of American financial assistance in the reconstruction of the country, there must be a complete understanding and co-ordination between the purely political and diplomatic branches of the government and those ministries entrusted with raising the finances for development purposes. If the Executive Yuan insists on one hand in enacting confiscatory and other legislation that drives away capital and on the other expects the Ministers of Finance, Railways, Cummunications, and the Chairman of the Reconstruction Board to create foreign credits and raise loans for carrying through their extensive reconstruction programs, it cannot expect to inspire confidence abroad in its good-faith and intentions. Instead of antagonizing the I.T. & T., Nanking should make every effort to co-operate harmoniously with an organization so intimately associated with the strongest financial powers in the United States. The friendship of this group will be one of China's greatest assets when the time comes for real constructive work.—G. B. R.

An Episode in American-Japanese Relations—I.

The Manchurian Freight Rate Controversy 1914-1916

By PAVI H. CLYDE, Ohio State University

THE recent history of American-Japanese relations in the Far East is marked by a little known, but highly interesting episode concerning freight schedules on goods entering South Manchuria. The incident is of importance since it was one of the few cases in which the United States Government protested on the basis of a specific stipulation of the Hay circular notes of 1899 on the open door. In reviewing this incident, the reader should recall that the Hay policy of the open door did not pledge the powers addressed to all those principles on which equal commercial opportunity may be said to depend. On the contrary, it merely sought to preserve such equality of opportunity as had *not already been destroyed by the establishment (in 1897-99) of* spheres of influence or interest. Unfortunately this fact has not been given general recognition, but it is of importance in any consideration of the topic here discussed.

Late in the spring of 1914 the South Manchuria Railway Company announced that it would offer reduced rates on through shipments of goods from or through Japan to the interior of Manchuria. American and British business interests in Shanghai were alarmed, for it was through Shanghai that the great bulk of American and British goods bound for Manchuria was shipped. The question was first brought to the attention of the State Department in Washington by Vice-Consul G. C. Hanson at Dairen on June 17, 1914. (1)

> Sir : I have the honor to report that this office has been informed by the South Manchuria Railway Company that the authorities in Tokyo have decided that the reduced rates on the Mukden-Antung section of the railway will be extended to specific through imports into Manchuria *via* Dalny and Newchwang from Japan only and that the same rates will not be applied to through imports from Shanghai. The reduction is to take place on and after July 1, 1914.
>
> The...decision is a serious one for importers of American piece goods, as most of this class of imports enters Manchuria through Newchwang from Shanghai. Therefore, piece goods from Japan proper (practically all of Japanese manufacture) entering Manchuria *via* any of the three South Manchurian ports will have a decided advantage over their American rivals, which cannot be classed as through goods from Japan unless they are shipped *via* Japan.
>
> While no one can attribute unfair play to the Japanese for fixing freight rates in Japan proper, Korea or even in the Leased Territory, to suit the best interests of their nationals, it appears that the application of reduced rates on through goods from Japan only is a discrimination in favor of Japanese interests. This resolves itself, then, into an effort to add another advantage to the already natural advantages the Japanese cotton goods manufacturer has in the matters of cheapness of labor in the manufacture of piece goods, of cheapness in bringing his wares to the Chinese market (due to proximity), of cheapness in disposing of the stock in Manchuria (due to the elimination of the " middle man " and the presence of Japanese dealers on the ground), and of superior financing facilities offered by the Japanese banking institutions to Japanese merchants. These are advantages due to nature and to Japanese initiative in matters of finance and trade, and credit is due the Japanese in that they have made use of them. But the new advantage is not a natural one nor is it one that could be called fair in a territory where legitimate competition, as viewed by western standards, is supposed to exist. All legitimate competition in Manchuria would benefit the Chinese consumer and, as the policy of the " open door in Manchuria," if it means anything, surely means that trade in Manchuria should be subject to legitimate competition so that the Chinese consumer as well as the foreign merchant would benefit thereby. (2)
>
> So far as Dalny is concerned, trade in American cotton goods through this port is nil, and, consequently, at present the new reduced rates as applied at this port are only of interest as a matter of principle. Trade through Newchwang, however, is vitally affected and foreign objections to the new scheme of applying rates will undoubtedly be heard in that quarter.

Commenting on the above dispatch, Minister Reinsch in Peking wrote to the Secretary of State on June 27 : (3)

> Although apparently not in violation of the literal wording of the undertaking concerning equality of commercial opportunity given by the Japanese Government at the instance of Secretary Hay in 1899 (Rockhill Treaties, pp. 194-6), such an arrangement would seem to be clearly contrary to the spirit of that undertaking and of the many similar assurances since given by Japan.

The American Ambassador in Tokyo, George W. Guthrie, on July 4, 1914, supported the views expressed by Mr. Hanson and went on to state to Secretary Bryan that : (4)

> The contention that manufacturers in the United States can avail themselves of the lower schedule by making Japan their point of transhipment instead of Shanghai is out of the question. While the products of Japan are handled in Manchuria by Japanese merchants, our goods are at present handled by Chinese agents, who transact most of their business through the head hongs in Shanghai, which we must under the circumstances make the center of distribution for our commodities, until American firms become convinced of the desirability of having their own agents in Manchuria.

The British Ambassador at Tokyo had already informed the Japanese government that he presumed that British goods shipped from Shanghai would enjoy the same benefits as those shipped from Japan. (5) Mr. Guthrie was therefore instructed to co-operate with his British colleague to obtain fair treatment for shipments from Shanghai over the South Manchuria Railway. (6) In reply to the overtures of the British Ambassador, Baron Kato, the Japanese Minister for Foreign Affairs, replied on July 20 that : (7)

> at present only through goods (either Japanese or foreign) from Japan *via* Dairen carried by vessels belonging to the Osaka Shosen Kwaisha or the Nippon Yusen Kwaisha are accorded the special reduced rates provided for by the notification in question ; but that hereafter, in the case of goods from foreign countries, where application is made for through transport, the place of destination of the goods being given as Mukden or certain specified stations north of Mukden, there will be no objection to such goods being accorded the same treatment, as regards freight over the lines of the South Manchuria Railway, as goods coming from Japan.

This view of the Japanese Minister was evidence of a willingness to compromise, but the problem was still further complicated by complaints of the foreign merchants at Newchwang that the South Manchuria Railway was discriminating against that port in favor of Dalny (Dairen), and Antung. (8) And when in October 1914

(1) United States, *Foreign Relations*, 1915, 594-595.

(2) Vice-Consul Hanson was not in reality clarifying the problem of the open door in Manchuria by offering his suggested definition. To say that the doctrine meant legitimate competition on the basis of western standards served merely to raise the questions, what is legitimate competition and what are western standards ?

(3) United States, *Foreign Relations*, 1915, 595.

(4) *Ibid.*, 597.

(5) United States, *Foreign Relations*, 1915, 597.

(6) *Ibid.*, 598.

(7) *Ibid.*, 600.

(8) *Ibid.*, 600.

new rates were established for shipments of goods from outside Manchuria, the American consul at Dairen reported that this schedule : (9)

> extends the through goods rate system so that through goods from countries other than Japan and Chosen (Korea) may receive equal treatment with through goods from those places.
>
> But through goods, to obtain the special rates, must be shipped on Japanese vessels, and therefore this order No. 47 is a discriminatory one which places the merchant vessels of all countries plying to this port from Formosa, Tientsin, Bombay, America, Australia, European ports and Shanghai at a disadvantage *vis-a-vis* Japanese ships on the same run.
>
> The action of the company . . . was intended to place foreign goods (non-Japanese) on an equality with Japanese goods.
>
> Its effect, however, is to give Japanese shipping an unfair advantage. It is made in contravention of Article VIII of the Treaty of Commerce and Navigation with Japan of February 21, 1911, whereby " all articles . . . may . . . be imported . . . in vessels of the other contracting party, without being liable to any other or higher duties or charges of what ever denomination than if such articles were imported in national vessels."
>
> Whereas the advantage given by special rates to the trade with Japan and Korea might be defended as being given to a part of Japan's coasting trade, which is specially exempted by Article XIII of the said treaty, the granting of the special rates to Japanese vessels engaged in distinctly foreign trade destroys the availability of this defence and places the act on a par with an act granting a reduction in customs duties to imports brought to Japan in Japanese bottoms.

There were thus, at this point, two phases of the freight rate controversy ; the arrangement of the rates so as to favor the ports of Antung and Dairen as against the port of Newchwang, and the special reduction of thirty per cent. granted to through shipments of goods carried in Japanese ships. It will be noted that Baron Kato's statement of July 20 did not contain any assurance that through goods brought to Manchuria in non-Japanese bottoms would receive equal treatment with those carried in Japanese ships. The chief objection to the freight tariff as between the port of Dairen and the port of Newchwang was the fact that the latter was not given the advantage in rates which its shorter distance from Mukden and other stations on the South Manchuria railway would seem to indicate it deserved. But from the point of view of the foreign merchants a far more serious situation was presented by the reduction of thirty per cent. which was extended to merchandise imported in vessels of the Japanese lines plying to Newchwang and Dairen. It seemed therefore to Minister Reinsch in Peking that : (10)

> From the point of view of American trade in North China and of the most essential policy for which the United States stands in the Far East, it would seem to be of the greatest importance that a definite assurance should be obtained from the Japanese Government that equality of treatment is not to be thus limited, to the great disadvantage of American shipping and incidentially of American commerce itself. Not only is the levying of freight charges openly discriminatory against merchandise not imported in Japanese bottoms, indirect violation of one of the specific principles enunciated by the American Government in 1899 as a part of the " open door " policy, to which the formal adherence of Japan has been repeatedly given ; but it is moreover, in contravention of Article VIII of the Treaty of Commerce and Navigation between the United States and Japan of February 21, 1911. . . . (11)

With a great mass of information before it, only a brief outline of which has been given here, the American State Department on November 19, 1914, issued instructions to Ambassador Guthrie asking him to consult with his British colleague in making certain representations to the Government of Japan, or if failing to secure this co-operation, the Ambassador was to bring the subject informally to the attention of the Minister of Foreign Affairs and endeavor to obtain assurance that the railway orders issued by the South Manchuria Railway Company would be so modified as to remove the discrimination against American trade. In making this informal protest several points were to be stressed :

> (1) With reference to Baron Kato's statement to the British Ambassador of July 20, " The Department will be glad to be informed whether or not the words ' foreign countries' used in the memorandum are meant to include China, which is ' foreign ' as regards Japan, but not as regards Manchuria. If China is included, then the Department presumes that goods belonging to Americans shipped from Shanghai into Manchuria may under the conditions specified obtain the same freight rates over the South Manchuria Railway as goods from Japan."
>
> " The context appears to show that China is not one of the foreign countries to which reference is made and that American goods to obtain the favored rates must be shipped through Japan and on steamers either of the Osaka Shoshen Kaisha or of the Nippon Yusen Kaisha."
>
> (2) " The Department notes further that American goods shipped to points south of Mukden cannot enjoy the favored rates unless they are shipped from Japan over the steamship lines mentioned."
>
> (3) " You should call attention to the repeated pledges given to the United States by Japan in support of the principle of equality of commercial opportunity in China, particularly to the note of Viscount Aoki to Mr. Buck under date of December 26, 1899, which gives the assurance asked by Secretary Hay that there should be ' no higher railroad charges over lines built, controlled or operated within such ' sphere ' on merchandise belonging to citizens or subjects of other nationalities transported through such ' sphere ' than shall be levied on similar merchandise belonging to their own nationals transported over equal distances.' "
>
> (4) " If it should be replied that American and European goods have only to comply with the conditions mentioned to receive the same rates, it should be pointed out that to require shipment over one or other of two Japanese lines and in certain cases from a Japanese port is not in accordance with the provision of the first paragraph of Secretary Hay's note to Minister Buck, which was agreed to by Japan and insures equality of treatment within the limits of China for navigation as well as trade."
>
> (5) " The discrimination mentioned, moreover, appears to be opposed to the understanding reached by Secretary Root and Baron Takahira in November, 1908, in an exchange of notes which declares it to be the desire of the two Governments to encourage the free development of their commerce in the Pacific Ocean and to be the policy of both Governments to support by all pacific means the principle of equal opportunity for commerce and industry of all nations in China." (12)

Accordingly, after receipt of further instructions from the State Department on December 8, (13) Ambassador Guthrie was able to report on January 6 that he had had several consultations with Sir Conyngham Greene, the British Ambassador, who said he had received no complaints or instructions since July 20 the date of Baron Kato's memorandum. He had informed his foreign office, however, that there was complaint that Newchwang was being discriminated against but had been advised that the Board of Trade did not consider the amount involved sufficient to justify further action. He was prepared, however, to conduct a full investigation to determine whether the American point of view merited representations to the Japanese government. (14) To aid the British Ambassador in ascertaining the true situation, Mr. Guthrie gave him a memorandum summarizing the views of the American Consul at Newchwang. (15)

MEMORANDUM (handed by the American Ambassador to the British Ambassador, December 31, 1914).

It is the opinion of the American Consul at Newchwang that American commerce is injuriously affected by four facts as follows :

> 1. That the order made in pursuance of the assurance given by Baron Kato on July 20 last to the British Ambassador that through shipments to Newchwang from " foreign " ports would be given the same rates as shipments from Japanese

(9) *Ibid.*, 600-601.
(10) United States, *Foreign Relations*, 1915, 604.
(11) With regard to the contention of Mr. Reinsch respecting the Hay policy, it is interesting to note that Hay instructed Minister Buck in June 1900 that Viscount Aoki, the Japanese Minister for Foreign Affairs, having questioned the binding force of the replies received by Hay, should be informed that he (Hay) did not expect the powers to reply in identical terms and that he was only interested in getting a formal statement of the policy they intended to follow in the regions under their control or influence.
(12) United States, *Foreign Relations*, 1915, 606-607.
(13) *Ibid.*, 608.
(14) *Ibid.*, 610-611.
(15) (Note given on following page).

ports, has not been construed to apply to Shanghai, which is not a foreign port as regards Newchwang, both being Chinese ;

2. That the order extending to shipments from Shanghai to Newchwang by vessels of the Nippon Yusen Kaisha the benefit of the 30 per cent. reduction to points north of Mukden, constitutes a discrimination against all other lines of shipping ;

3. That the restriction of the reduction of 30 per cent. to goods from Shanghai consigned directly to points north of Mukden puts such goods, destined to points south of Mukden, even when they are shipped from Shanghai by Nippon Yusen Kaisha vessels, at a disadvantage as compared with goods shipped from Japanese points to points south of Mukden ;

4. That goods landed at Newchwang and temporarily stored there before being forwarded are not given the same discount as goods consigned directly to points beyond. It is urged that the same discount could easily and safely be granted in this case, as the bills of lading would have to be produced as proof of the origin of the consignment.

Later, on January 14, 1915, Ambassador Guthrie was able to state that the British consul at Dairen had been informed by the South Manchuria Railway Company that :

> the specific through rates are applicable to the specific through goods carried by any steamship line, whether under a foreign flag or the Japanese flag, who have entered into special arrangements with this company concerning the transportation of through goods.(16)

Considering the limited British interests involved, Sir Conyngham Greene did not feel disposed to join in any representations which might be made to the Japanese government,(17) but on March 6 Ambassador Guthrie addressed a lengthy communication to Baron Kato calling attention to the alleged discrimination against American cotton goods shipped from Shanghai to consignees at Newchwang and from there forwarded to purchasers at various points in Manchuria north of Mukden. (18) The reply given by Baron Kato was reported by Mr. Guthrie as follows : (19)

> . . . . he told me that the above-named company had desired to promote the commerce of Dairen and to favor it even at the expense of Newchwang, for the reason that at the latter place part of the trade to Mukden and beyond went by the Chinese railway, whereas by Dairen the whole went by the South Manchuria road. He said that as the matter had been explained to him the regulations did not discriminate between the trades of different countries at all, American trade being able to take advantage of the regulations just as Japanese trade had. I pointed out that while this was theoretically true, practically it was not correct ; that American trade all went by way of Newchwang, where it was very much discriminated against by this regulation ; that while theoretically goods going from Shanghai by way of Newchwang could get the benefit of this discount on through rates provided that they were billed through, the only steamship line which could issue the through bills was composed of the South Manchuria Company's own ships. Baron Kato admitted that this point should be corrected and arrangements made to permit other lines to send goods through.
>
> As to the regulation providing that only through goods could be entitled to the discount, he seemed convinced that American trade had no just cause of complaint thereat. He said that as a matter of fact Japanese merchants at Dairen had complained bitterly of the same thing, alleging that insistence upon this point would drive them out of the trade. In spite of this, however, the company had adhered positively to the regulation.
>
> It will be noted by the communication from the Foreign Office that the railway company expresses its willingness to form a connection for joint transportation with any foreign steamship company so desiring, and to allow to such foreign company the same reduced rates on through goods which are now given to through goods carried by the railway company's own steamers, and that this regulation applies both at Newchwang and Dairen.

Nevertheless this frank explanation by the Japanese government was not entirely satisfactory to the State Department, and a month later Mr. Lansing, the acting Secretary of State, said that it still appeared that discrimination existed not only on shipping through Newchwang but on shipments through Dairen as well in cases where the goods were not carried in Japanese vessels.

> You are instructed, therefore, to bring the matter once more to the attention of the Japanese Foreign Office and express the hope and confident belief of this Government, that the Imperial Japanese Government will require the authorities of the South Manchuria Railway so to modify their published rates as to secure that equality of commercial opportunity for all nationalities in Manchuria, to the maintenance of which both our Governments are pledged.
>
> With respect to the trade through Newchwang, attention should be called to the fact that the discrimination is the more marked for the reason that no line of Japanese steamers appears to be engaged in carrying goods to that port, while all other lines are denied the reduced rates so that shipments through that port are practically without any relief. (20)

On the same day, April 17, 1915, Secretary Bryan instructed Ambassador Guthrie by wire to

> Request Foreign Office to instruct railway authorities to grant the reduced rates to shipments in other than Japanese vessels whether to Newchwang or Dairen as necessary to preserve open door. (21)

This was in response to urgent representations of the American consul at Dairen that discrimination against American vessels still continued. Further delay resulted because the Japanese authorities felt it necessary to consider carefully the form of contract which should be used in granting the special rates to foreign shipping firms. (22) The view has been expressed that Japan was stalling for time, though it must be admitted that there was little to be gained by such a course. On the other hand the American Chargé, Post Wheeler, at Tokyo, was embarrassed considerably by the instructions of his own government for on June 9 he wrote to Mr. Bryan : (23)

> The Department's instruction No. 140 . . . . states that " no line of Japanese steamers appears to be engaged in carrying goods to that port " (Newchwang). According to the report of the Commissioner of Customs for the year 1913 (the latest report on file at this Embassy), clearances and entries of Japanese steamers at Newchwang totaled 298, as against 177 British and 114 Chinese vessels. What proportion of these ply between Newchwang and Shanghai, these statistics do not show ; I am informed, however, by the Nippon Yusen Kaisha that this company maintains a regular service on that route.

It was somewhat humiliating for Mr. Wheeler to be asked to base his representations on data from the State Department which were obviously incorrect.

From June 23 to November 4, 1915, it appears that there were no developments of importance. (24) On November 4, however, Ambassador Guthrie reported on a communication from the Foreign Office. It was the opinion of the Japanese that there was reason to discontinue the negotiations. This view was based on the statement of Consul Williamson at Dairen to Mr. Y. Kubo, secretary of the South Manchuria Railway :

> . . . . I beg to state that as the desirability or not of entering into an agreement with your company depends a great deal upon the nature of the agreement, none of the American shipping firms yet wishes to have its name mentioned in connection therewith ; at the same time, all are desirous of learning the requirements and of securing a sample copy of an agreement form . . . . (25)

Ambassador Guthrie was therefore of the opinion that :

> Under the circumstances, as there is no American steamship line touching at Dairen at present, I have not considered the matter urgent . . . . (26)

The real crux of the matter was the American shipping companies were devoting their attention not to matters of expansion but to consideration of the new American shipping laws (the Seamen's Laws) which had been passed by the American Congress but which had not as yet been put into effect. (27)

(*Continued in September issue*).

(16) United States, *Foreign Relations*, 1915, 612.
(17) *Ibid.*, 613.
(18) *Ibid.*, 614.
(19) *Ibid.*, 616.
(20) United States *Foreign Relations*, 1915, 618.
(21) United States, *Foreign Relations*, 1915, 618.
(22) *Ibid.*, 619.
(23) *Ibid.*, 619.
(24) No instructions or despatches appear in the 1915 volume of *Foreign Relations* between the dates given.
(25) United States *Foreign Relations*, 1915, 622.
(26) *Ibid.*, 624.
(27) *Ibid.*, 614.

Malaya's Biggest Engineering Enterprise

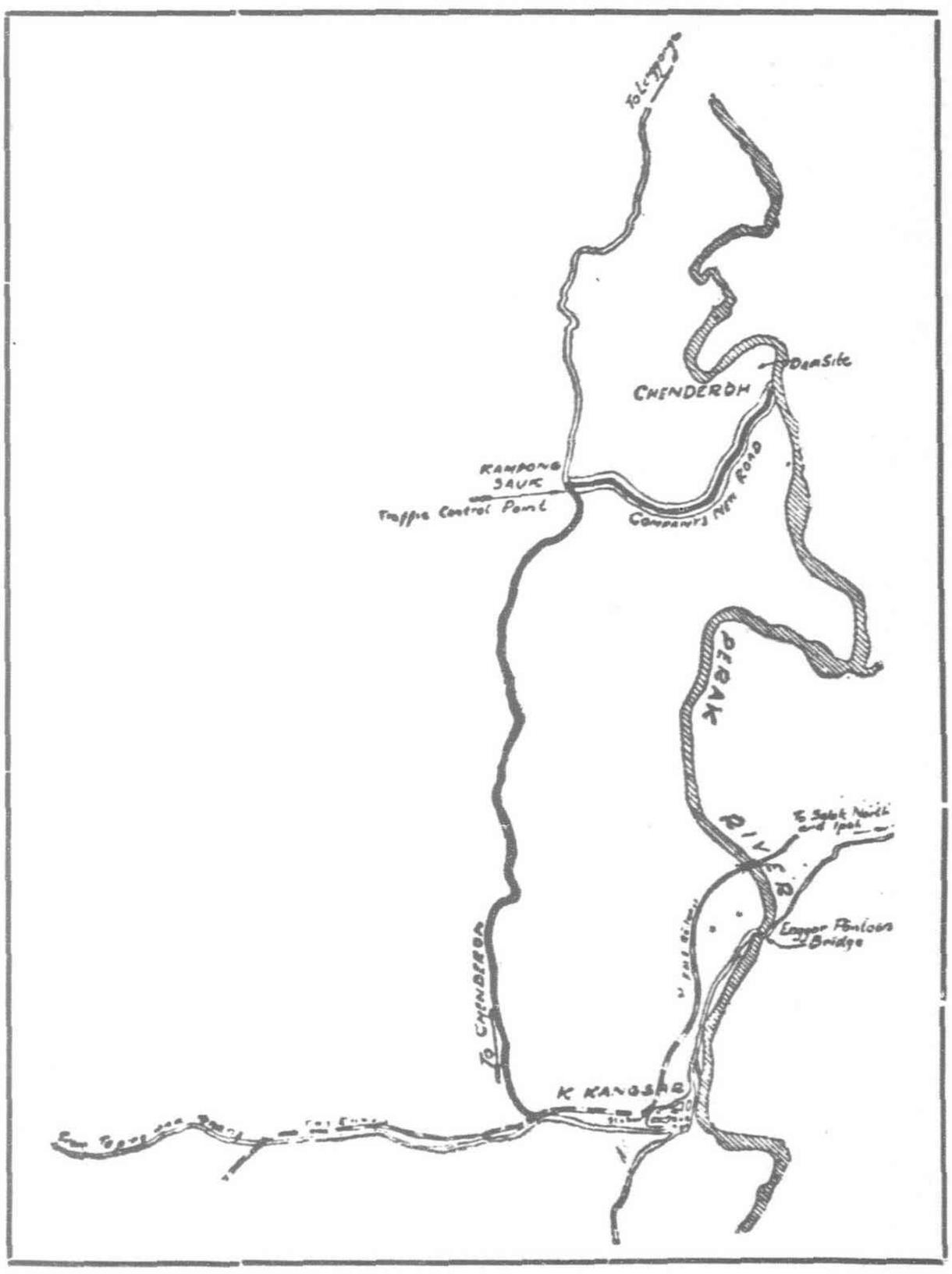
Completion of the Chenderoh Dam Over the Perak River

THE formal opening of the Chenderoh Dam, on June 28, by Sir Cecil Clementi, Governor of the Straits Settlements and High Commissioner of the Federated Malay States, marks the completion of Malaya's biggest engineering undertaking. Several articles describing the progress of the construction work and electrical equipment have appeared from time to time in this magazine, but the following additional information given out by the Perak Hydro-Electric Company, Ltd., on the occasion of the opening ceremony is of interest.

The great dam across the River Perak at Chenderoh is of the Ambursen type and of great strength. In its construction, which has taken over three years, nearly 150,000 cubic yards of concrete and about 6,000 tons of steel reinforcing bars have been used. The dam is of solid concrete at both ends, but hollow in the center, where a concrete frame is reinforced with steel bars. As each section was constructed the river was diverted from it. The bed of the river was then excavated until solid rock for the massive foundations was reached. A Sector gate 100 feet wide, in the center of the dam, controls the level of the lake.

The installation in the power house includes three water-driven turbo-alternators each of 9,000 Kw. capacity running at a speed of 94 revolutions per minute, and generating current at 6,600 volts. This voltage is stepped up to 66,000 in an outdoor substation near by, and fed into the main transmission lines which extend from Chenderoh to Malim Nawar.

At Malim Nawar, at the southern end of the Power Company's area, a steam station has been in operation since December 1928. This station contains coal-fired boilers with powdered fuel equipment of the latest design, and three turbo-alternators of 6,000 Kw. capacity each. The machines run at a speed of 3,000 revolutions per minute, and generate current at 6,600 volts which is stepped up through outdoor substation to pressures of 22,000 volts for supplying the Kampar area, and to 66,000 volts for supply to the main transmission lines.



Location of Chenderoh Dam

It was not intended originally to commence the supply of current until the water power station at Chenderoh was ready for commercial operation, but so great was the demand for an earlier supply, especially for new dredges, that it was decided to increase the size of the steam station, and to begin to supply from it at the earliest possible moment. There has already been built up a load for which over 70,000,000 million units per annum are called for, which will be transferred to the hydro station, when it is ready for operation.

The primary 66,000 volt line between the two power stations is 52 miles long in duplicate. It is carried on steel towers 70 feet high. The usual span between towers is 830 feet, but across the Perak and Plus Rivers it measures 1,000 feet. A great task confronted the engineers who surveyed and erected these towers and strung the lines, for swamps, jungle, rubber estates, roads, rivers, and railways had to be traversed. Many special foundations had to be constructed, mainly of concrete resting on piles driven 30 feet into the slimes.

From a number of transforming stations the current is stepped down to 22,000 volts for the secondary transmission system. This is carried to the principal mining centers where the current is again stepped down to 6,600 volts for local supply lines to each consumer's premises. There are already 10 of these secondary substations in use. From these substations some 11 towns derive their supply for local lighting and cooking purposes.

Sir Arthur Gridley, representing the operating company at the official opening, touched on another important feature of the construction of special interest to tropical engineering contractors. The same climatic conditions which decimated the laborers engaged in the construction of the Yunnan Railway, nearly thirty years ago, were encountered in the construction of the Chenderoh Dam. How the Perak Hydro-Electric Company successfully overcome these deadly malarial fevers and protected the lives of their workers, was referred to by Sir Arthur Gridley in the following words:

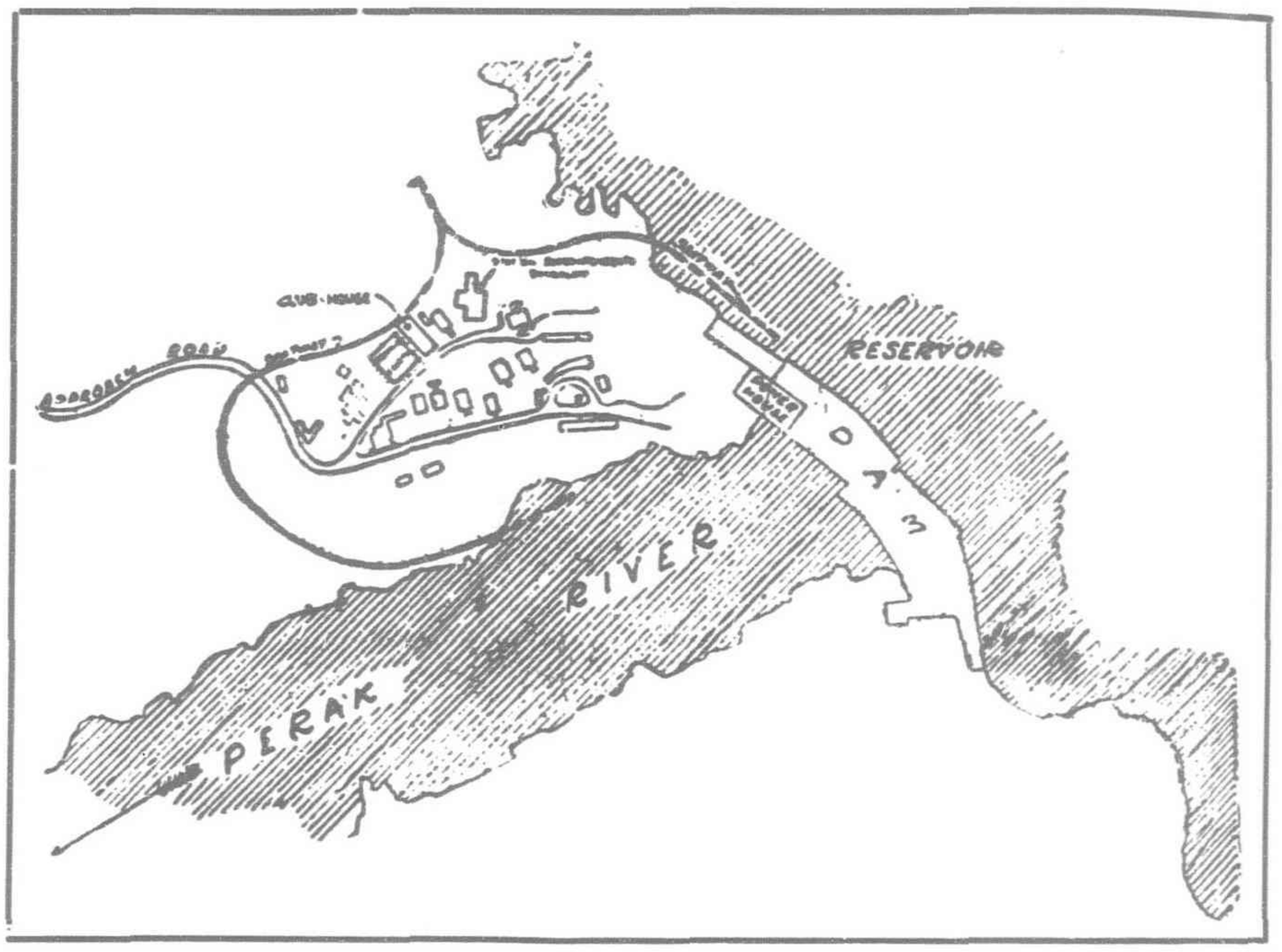
"We are about to commence work on this site when the great flood of December 1926 swept in torrent down the River, and delayed the start of the construction works. From that record flood we learned certain lessons which were remembered when the design in detail of the Dam was being worked out. We took over some 3,000 acres of jungle, much of it infested with the malaria carrying mosquito. We called in that great expert mind of Sir Malcolm Watson to advise us upon the measures of anti-malarial treatment which would safeguard, as far as human knowledge would allow, the health of the thousands of workmen and the Management Staff that would, in due course, be employed and housed here. Under that advice, and the subsequent guidance of Dr. Waugh Scott, a health record unsurpassed anywhere else in mosquito infested tropical regions has been achieved the death rate having been under five per cent.

"The cost involved, though heavy, has been saved many times over. Had the labor force once got evidence that the area was an unhealthy one, it would have been difficult, if not impossible, to have replaced those who refused to stay, and the time required to complete the work would have been considerably lengthened, and the cost heavily increased. This achievement has been rightly described as meriting an 'Epic.' It is now quoted all over the tropical world

as an example of what can be done by following the teaching of Science and experience."

Sir Cecil Clementi, also rendered tribute to the splendid work of the medical experts charged with maintaining the health of the workers, a recognition of the truth that the success of a tropical construction job of any magnitude depends as much upon the doctor as the engineer.

High praise is also due to the anti-malarial prophylactic work, done by Dr. Scott and his staff, which enabled the labor of construction to proceed without undue loss of life in an area where a malaria rate running as high as 20 per cent. and more per mensem had been known to occur. There was resident here during the construction period a population of over 4,000 souls, including more than a hundred Europeans: but the annual death rate for the whole period of construction was only 4.96 per mille. These figures show that construction was at no time hindered by sickness among the labor force, and that malaria was definitely kept at bay. This anti-malarial work by Dr. Scott at Chenderoh in Perak and by Dr. Hunter at the Gunong Pulai Reservoir in Johore has set a standard and achieved results which are of value not only to Malaya but throughout the world.



Chenderoh Site Plan

Space does not permit reproduction of the eulogies heaped upon the Contractors for the Dam and Power House (Messrs. Topham, Jones and Railton) or the Consulting Engineers (Messrs. Rendel, Palmer and Tritton and the Swedish V.B.B.). Some reference to the financial end of the enterprise, however, is not out of place.

The original scheme of the Perak River Hydro-Electrical Power Company, was to provide for an annual output of 100 million units from three sets of plant, each of 9,000 kilowatts capacity (one being a spare), installed at the Chenderoh hydro-electric station, with a standby steam set of 5,000 kilowatts capacity at Malim Nawar, together with the necessary transmission lines, substations etc. The captial cost of this scheme was put at £2,320,000, and it was estimated that the work would be completed in three years from the end of 1926. During 1927, however, it was deemed advisable to extend the steam station at Malim Nawar from a capacity of 5,000 to 18,000 kilowatts at an estimated increase in cost of some £260,000; and, with this increase in capacity, the total annual output of the Company was estimated at 160 million units as compared with the 100 million units of the original scheme. Various factors, contributed both to delay completion and to increase very largely the cost of construction, so that the capital of the Company now stands at £4,450,000. The Government holds 500,000 Preference Shares, and 75,000 Ordinary Shares, in the undertaking, and a few months ago advanced on secured loan the sum of £850,000. Approximately half of this sum was for additional assets, and the remainder represents excess cost of the originally planned work. The increased size of the Steam Station absorbed £250,000 and to meet demands for current, about £94,000 was expended on substations and lines not contemplated in the original scheme. The roads proved much more costly to construct than was expected, and absorbed £106,000. All these items are in the nature of additional assets which have cost £450,000 out of the £850,000. The balance is excess cost, the Dam and Power House having cost about £350,000 extra, and the electrical and mechanical equipment generally about £50,000 more. The excess cost of works originally contemplated has been about 18 per cent. The remainder of the money has provided additional assets. The plant and equipment now installed is capable of an output of electricity, at least 60 per cent. more, than the originally planned scheme provided.

The Government's financial interest of £1,425,000, is approximately one-third of the total issued Capital of £4,381,000.

New Edgar Allen Publications

The Third Edition of The Edgar Allen Steel-Foundry Book has been enlarged to 52 pages, thoroughly redesigned and made to include many facts in regard to the manufacture, heat-treatment, and properties of castings in seven different kinds of steel. Although this book does not set out to teach buyers their business or to catalog all the standard types of steel castings, it does give a full description of conditions in steel foundry practice and enables buyers to cut out delay in receiving quotations and in delivery of castings, to secure lower prices and to avoid errors leading to unprofitable and unnecessary expense.

Rotary Kilns and Coolers

Another important publication to reach us, is Edgar Allen and Company's new catalog on Rotary Kilns and Coolers for Cement Plants. This is the first time that this well known firm has gathered together in one publication particulars of the range of kilns and coolers manufactured at their works. The catalog describes three different types of rotary kilns, the latest of which is called the Edgar Allen "Tiger" kiln. This is a combined kiln and cooler introduced recently into the cement industry. There are also notes on air seal rings, driving gear, rotary lime plant, rotary kiln firing, rotary coolers etc., all highly illustrated with typical installations in the most important cement factories throughout the world.

Chekiang Development Program

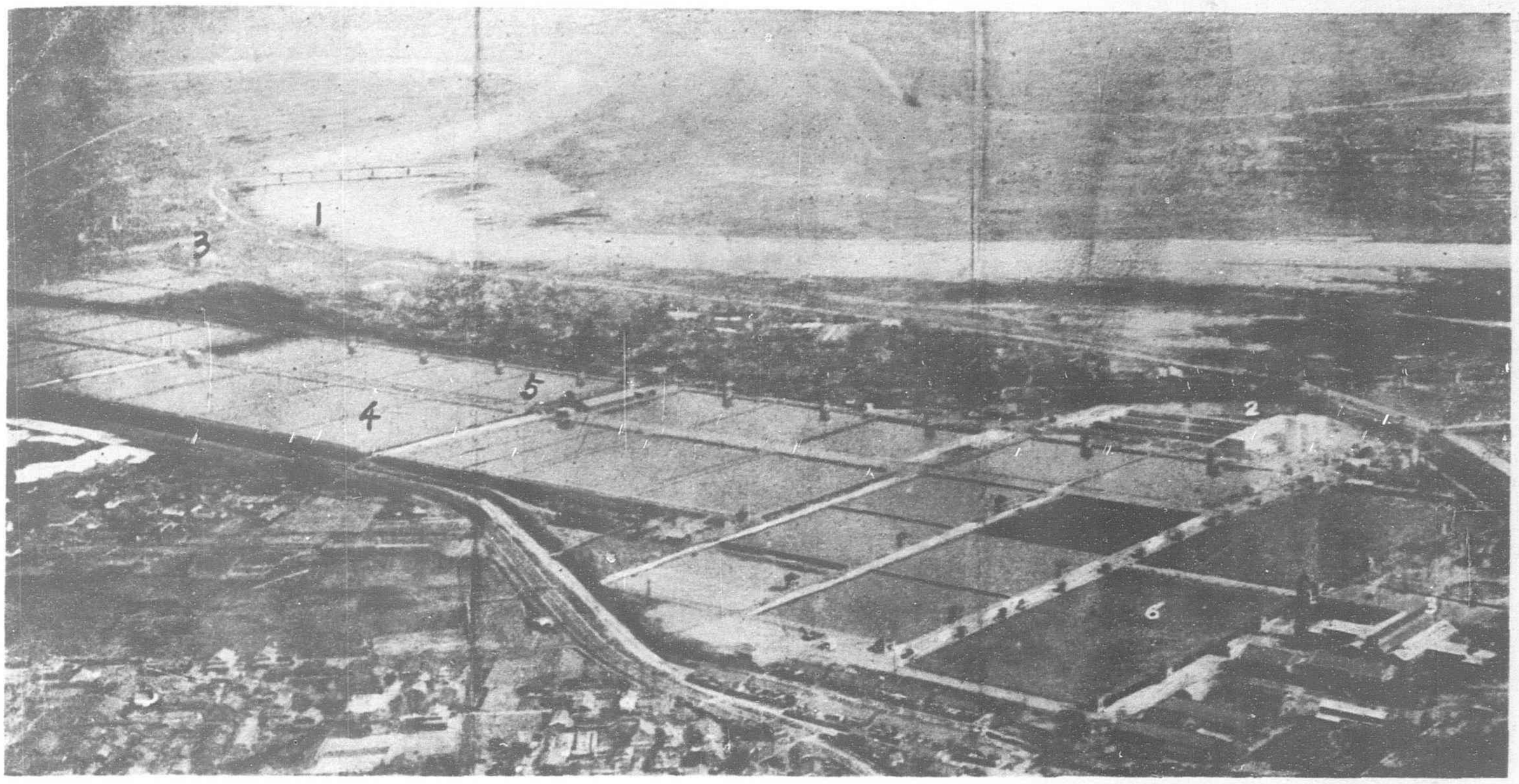
(*Continued from page 407*).

Hangchow-Fenghiao; Hangchow-Changshan; Yuhang-Changwa; Hangchow-Kingyuan; Hangchow-Taishun; Hangchow-Pinghu; Kashan-Huchow; Changshan: Kienyeh-Shunan; Lungyu-Changshan; Lanchi-Kinhwa; Lisui and Shaohing-Linhan. The total length of these lines is 4,548 li or about 1,500 miles. The Hangchow-Fengkia line will be extended to Shanghai, a distance of about 45 miles. The wires were changed in the Hangchow-Taishun and Hangchow-Kingyuan circuits in 1929.

During 1930, the program calls for the construction of the Ningpo-Chinhai line, the Wukang-Tehtsing; Changshan-Siaofeng and the Kashing-Chapu lines. Further plans are being prepared to connect up every city in the province with long-distance telephone lines, as well as branches hooking up the smaller towns and villages. The sum of $6,943,152 has been allocated from the general construction funds for telephone extension. In addition, $710,612 will be expended on the erection of a series of wireless telegraph stations.

River Conservancy

The sum of $4,591,200 has been allocated for constructing flood-protection embankments along the worst places on the Chientan River. A more complete scheme of river improvement is being studied, providing for dredging the channel and building wharves at Hangchow. A rough preliminary estimate of the cost of this work is over $8,000,000.



Aerial View of the Osaka Municipal Waterworks

The harbor city of Osaka, Japan's most prosperous industrial center, has just completed the 4th extension work of its waterworks at Kunishima, by the western embankment of the New Yodo River. As the result, the capacity of the city's waterworks has been enlarged to a maximum of 578,000 cubic metres or more than 127,000,000 gallons a day. The extension work was carried out on the basis of calculations that the population of Greater Osaka may reach 3,100,000 in 1936, and that 2,750,000 out of the total would have to be furnished with water by the city waterworks, at an estimated rate of 0.21 cubic metres or 46 gallons per head a day. The work was started in August, 1925, and was completed in March, 1930, at the cost of Y.8,000,000. The figures in the picture represent : 1.—Intaketower ; 2.—Rapid filter system ; 3.—Service pump station ; 4.—Settling reservoirs ; 5.—Filter beds ; 6.—Clean water reservoirs covered by beautiful lawn.

Far Eastern Waterworks—I

The Municipal Waterworks of Osaka

Development of Waterworks in Japan Outlined

By EISABURO KUSANO

THE Osaka Municipality celebrated the completion of the 4th extension program of its waterworks located at Kunishima, in the north-western outskirts of the city, by the New Yodo River, in March, this year.

A careful comparative study by the Osaka city authorities of the population and its increasing tendency in districts covered by the Municipal waterworks, as well as of the percentage of those supplied with water against those who are not, found in 1924 that the population would increase to approximately 3,100,000 in 1936 and that 2,750,000 out of the total would have to be furnished with water by the city waterworks.

It was on the basis of these calculations that the city started on its present Y.8,000,000 program in 1925 to extend the capacity of its Kunishima waterworks to a maximum of 3,200,000 *koku* or 578,000 cubic metres (or about 127,040,000 gallons), the estimated *per capita* maximum being 1.16 *koku* or 0.21 cubic metres (or 46 gallons) per diem. And, the extension work has just been completed after six years of time.

History of Waterworks in Japan

It was in 1887—20 years after Japan abandoned her seclusion policy that had lasted for 300 years and came into touch with the world at large—that the first modern waterworks in this country was built in Yokohama. Prior to that date, there was none which might be called a waterworks in its present sense of the word.

There did exist the system of leading clean water from deep wells, gorges, and rivers by wood or bamboo waterway for some distance before the city of Yokohama had the distinction of being the first city in Japan to install the modern waterworks, but in these old systems, practically all of which were very small in scale, and the clean water was used as it is, although sometimes a simple sand-filtering method was applied in case of necessity.

It is very few in number, but some of these simple system of leading clean water was built in a considerably large scale. For instance, there were the Kanda Josui and the Tamagawa Josui which were constructed in Tokyo when the city was still called by its old name of Edo in the Tokugawa Shogunate régime. In the early period of the Meiji restoration of the Imperial régime, the city of Yokohama built a wooden system of distributing clean water that was led into the city limits from a distant source. Nevertheless, it is out of question to compare these primitive systems with the modern waterworks especially in view of the perfection of the present day system in its equipment of waterway, filteration, and distribution.

With the rapid introduction of the occidental civilization in this Island Empire following the opening of her ports to foreign trade, and particularly since foreigners began to reside at such port cities as Yokohama, Nagasaki, and Hakodate, the city authorities realized the urgent need of carrying out various advanced adminis-

NOTE : See *Far Eastern Review*, July, 1927, number

trative enterprises, including the construction of waterworks. It was partly due to stimulation of this urgent need that Yokohama constructed the foregoing wooden waterway system in the 4th year of Meiji or 1871.

It is only natural that the Yokohama city authorities should soon discover that the primitive system that they built could not comply with the growing need of water supply with any satisfaction. Subsequently, an English engineer, called Mr. H. S. Palmer, was called for to draft a plan of a perfect waterworks in 1885, and it was accomplished two years later at a cost of Y.1,075,000.

First Waterworks in Japan

This first waterworks of Japan established in Yokohama had its intake house at Mikagimura, Shimo-Tsukuigun, Kanagawa Prefecture, in the neighborhood of the point where two rivers, the Sagami-gawa and the Doshi-gawa joined each other. From this intake house, the water was led by iron water mains for a distance of almost 25 miles to Nogeyama in the city of Yokohama where it was filtered and distributed, to supply a population of 100,000 at the maximum with clean water.

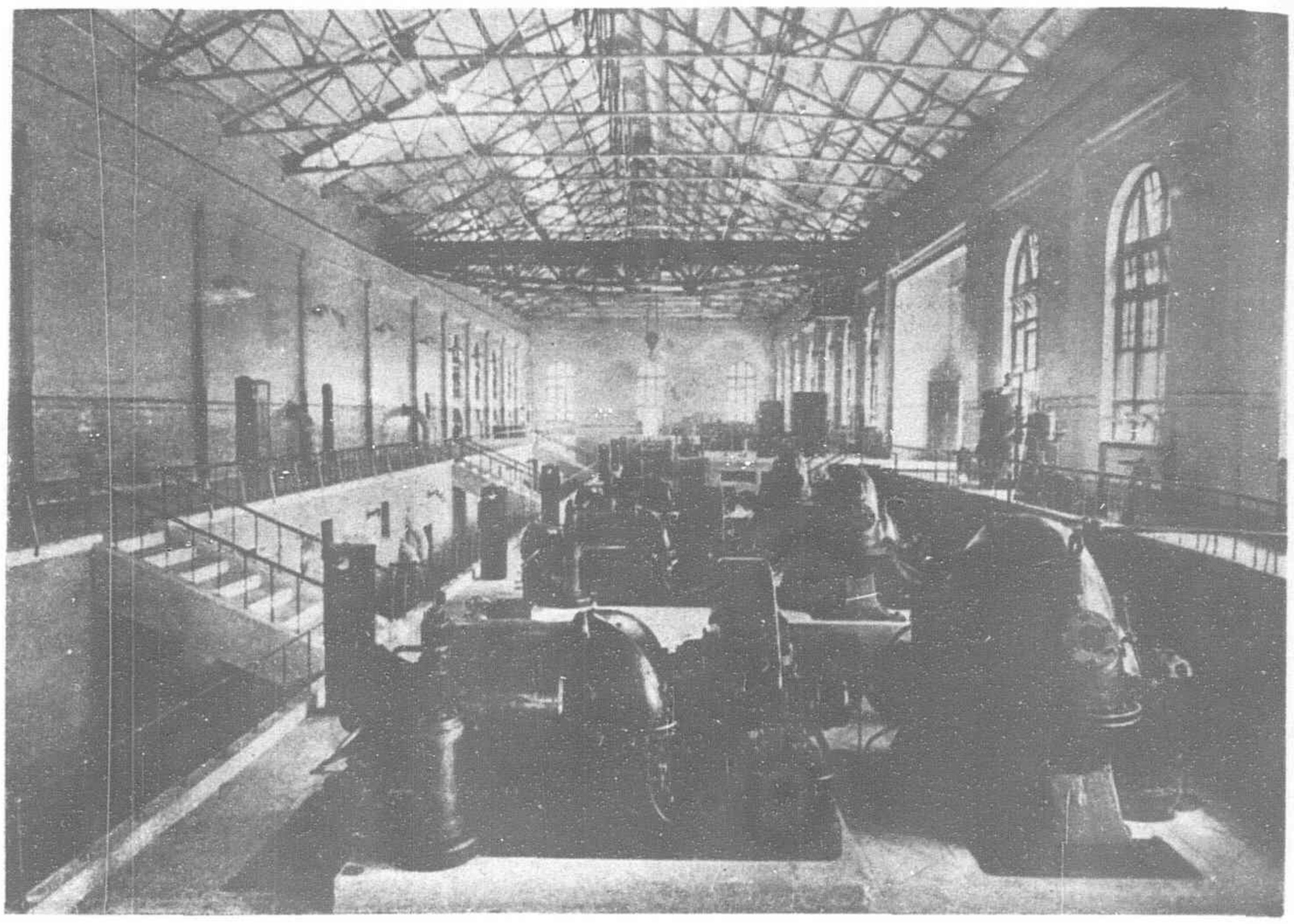
As the population steadily increased in consequence of the rapid development of the port city, so the capacity of the Nogeyama waterworks was increased after a series of extension work, building larger filteration beds and clean water reservoirs, and extending the distribution water mains.

Spending well over Y.7,000,000, the city completed in 1915 its extensive program of increasing the capacity to a maximum of 500,000 *koku* or 19,850,000 gallons per diem to supply a population of 800,000. But they soon found that it was not sufficent as the *per capita* consumption of water registered an enormous increase in proportion to the incessant growth of the population. In August, 1923, for instance, the maximum consumption of water per day during the month exceeded 600,000 *koku*, or 23,820,000 gallons. Consequently, it became a question of time that the city again extend its waterworks. Meanwhile, the devastating earthquake wrecked the city in September of the same year, causing serious damage to the system. The Nogeyama clean water reservoir, among other things, sustained such a severe shock that it went out of function.

Emergency repairs were then effected without losing time on the intake house, the waterway, and the Nishitani clean water reservoir, in addition to a general repair work on the distribution system all over the city. As a result, the city was able to resume the water supply in March, 1924. Apart from these emergency repair works, a thorough-going restoration work was started in April, 1924, on the Nogeyama and Kawai clean water reservoirs at a cost of Y.3,000,000, and it was completed in 1927.

Enactment of Waterworks Act

Following the completion of the first modern waterworks in Yokohama in 1887, there appeared many cities, towns and villages where the construction of waterworks was contempiated. Especially in large cities, the plan of building waterworks became one of the most important part of their sanitary and fire-fighting undertakings. It eventually stimulated the Government to enact and promulgate the waterworks act in February, 1890, for the double purposes of encouraging the construction of waterworks and also of controlling them under uniform regulations.



The Kunijima Central Pumping Station of the Osaka Waterworks. The Largest and Most Modern Pumping Plant in Japan. Escher Wyss Turbines and Pumps

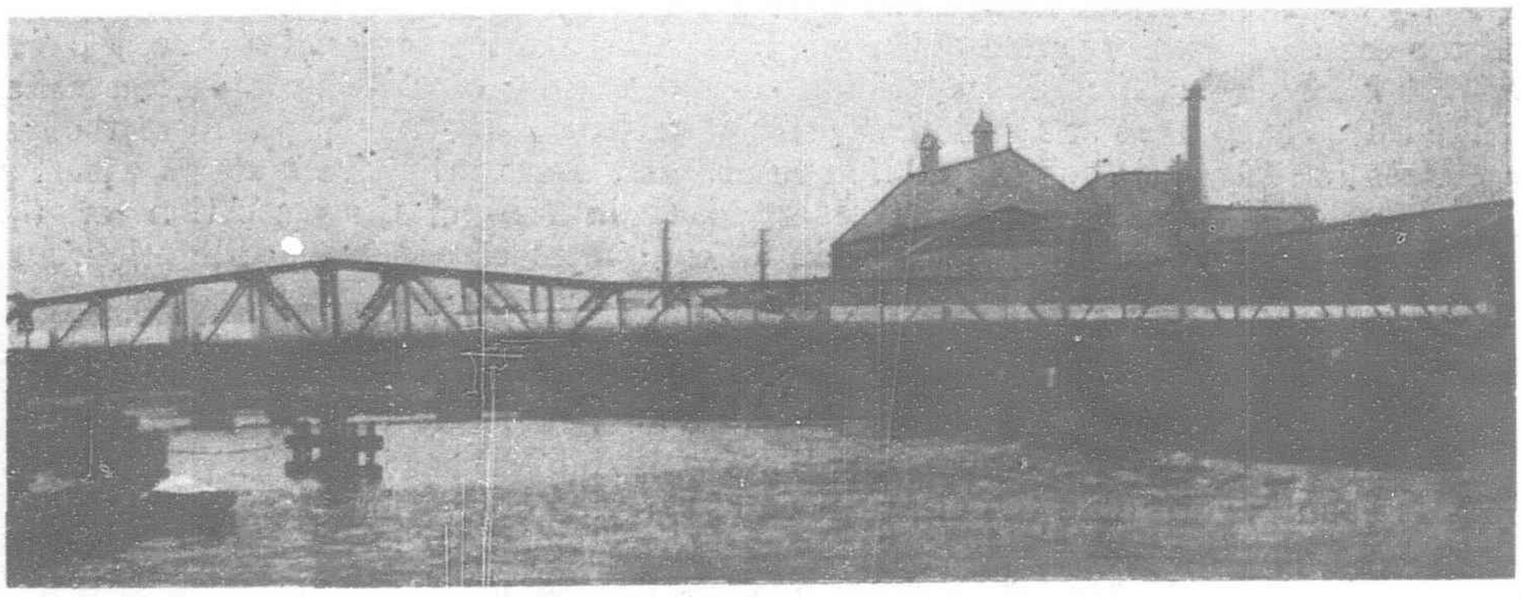
Hakodate was the second city where the waterworks was established in Japan, followed by Nagasaki, Osaka, Tokyo, Kobe, Okayama, Hiroshima, Shimonoseki, and elsewhere. On April 1, 1925, there were 49 cities which had completed the waterworks, in addition to 64 towns and villages and 15 public institutions (other than cities, towns, and villages) that were equipped with their own waterworks. Moreover, there were 14 cities, 38 towns and villages and 13 public institutions which were building waterworks, while two more applications were being filed with the Government asking for the license for constructing waterworks.

The *per capita* volume of water supplied by these waterworks in Japan differ from one to another, in accordance with the stage of prosperity reached by the individual cities, towns, and villages, as well as due to difference of the climate and geographical conditions; prosperous industrial cities and port cities, for instance, naturally supply more water than a quiet, rural town. Generally speaking, however, it varies from 2.5 cubic feet to 4 cubic feet, and most of the waterworks in Japan are established on the calculation of supplying 3 cubic feet of water per head a day, on the average. The maximum capacity of these waterworks is about 150 per cent. of their daily average of water supply.

Water Sources

In view of the fact that there are innumerable rivers flowing in all directions in Japan, the number of waterworks which collect water directly from the running water of rivers is the largest, it corresponding to about one-third of the entire number of waterworks in Japan. The cities of Tokyo, Osaka, Yokohama, Nagoya, Hiroshima, Okayama and many others adopt this system. Next comes the system of accumulating water at reservoirs leading water from gorges and rivers by means of building a dam on a river to regulate the flowing quantity of water of the river. Representative cities that adopt this system are Kobe, Nagasaki, Shimonoseki, Moji, Akita, and elsewhere. The cities of Hakodate, Otaru (Hokkaido), and Wakamatsu (Kyushu) adopt the foregoing two systems at the same time.

One of the remarkable tendency in Japan's waterworks building enterprise is that the system



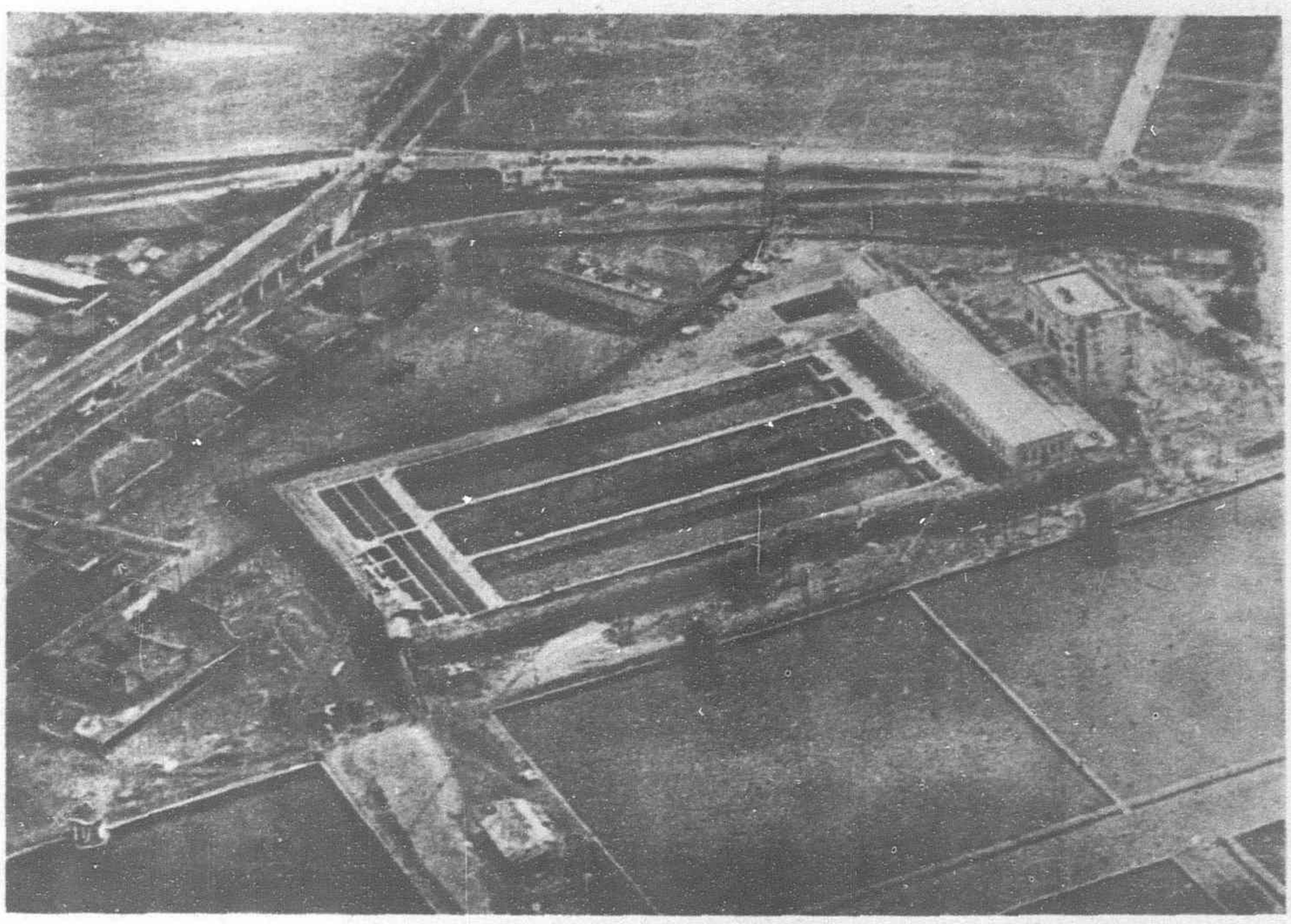
Bridge Across the Tosabori River in Osaka Carrying Water Main

of burying horizontal gallery under the river bed to collect water is increasing. The international park city of Nara, the rising cities of Tokushima and Kochi in Shikoku Island, and quite a number of other cities adopt this system. On the other hand, the number of waterworks which obtain original water supply from spring water, deep wells, and lake is comparatively small. The cities of Mito, Matsumoto, Kumamoto (Kyushu), Kagoshima (Kyushu), and elsewhere have the system of collecting water from springs, while the ancient capital of Kyoto get water from Lake Biwa ; the city of Otsu which is located right by Lake Biwa also collect water from the same lake.

Meanwhile, the cities of Saga (Kyushu), Omuda (Kyushu), Fukui and Takata are the representative cities which adopt the system of collecting water from deep wells.

As for the method of purgation, most of the waterworks in Japan adopt the sand filteration system. Those waterworks which collect water directly from rivers almost invariably have settling reservoirs in order to remove floating obstacles before the water is sent to the filteration bed. The speed of filteration varies from eight to 12 feet a day, the average speed being 10 feet a day. But recently, the speed of filteration shows a tendency to increase, especially in the systems adopting the method of collecting water from horizontal gallery buried under the river-bed. The city of Osaka, among other cities, has just built a rapid filteration plant where the filteration speed is increased to 400 feet a day, though this waterworks collect water directly from the New Yodo River. The cities of Kyoto, Saga, Omuda, and several others also have the rapid filteration system, the filteration speed ranging from 200 feet to 400 feet a day.

The application of the chlorination, as evidenced in Osaka and Kyoto, is another feature of the recent filteration system in Japan.

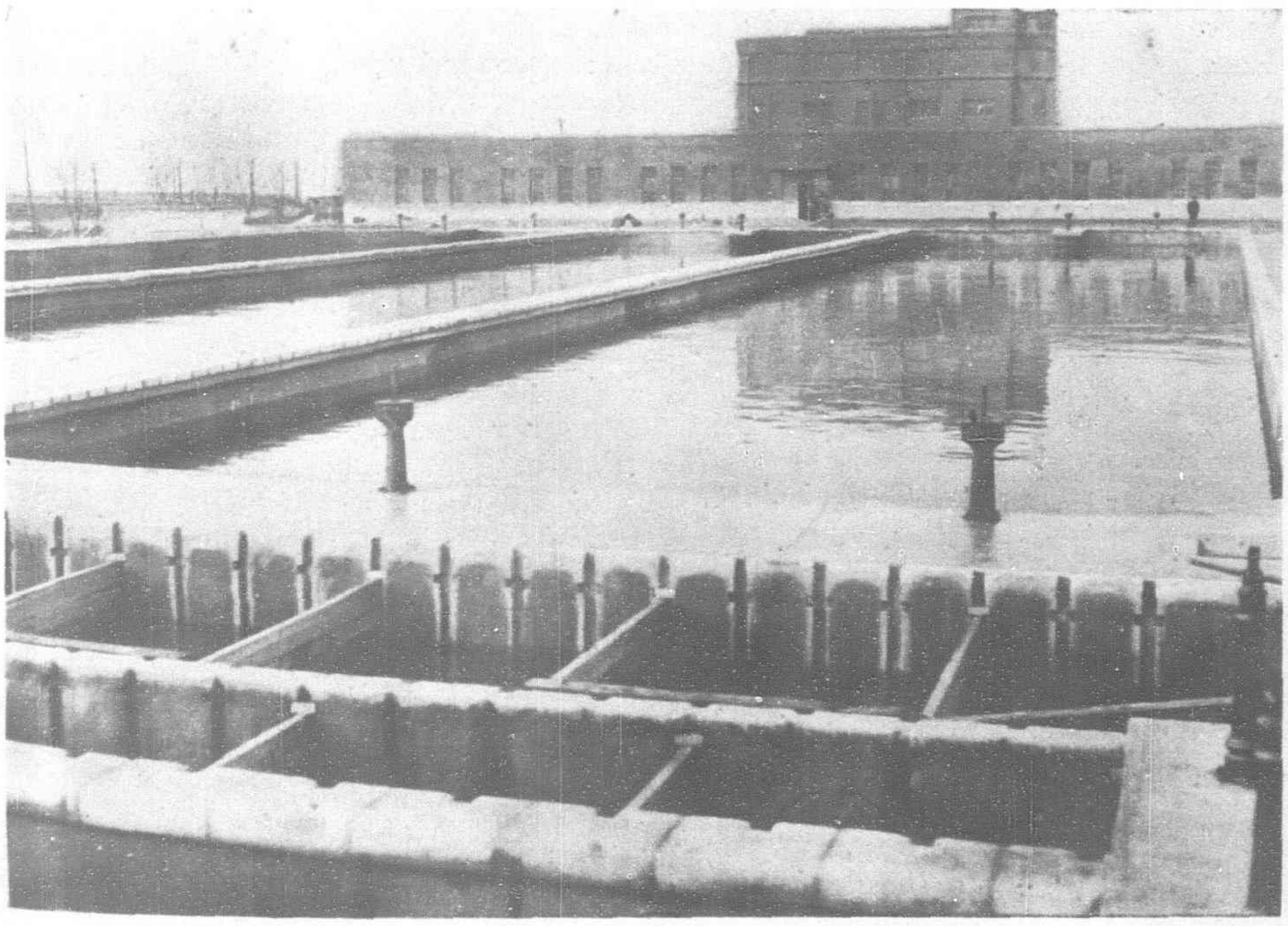


General View of the Rapid Filter System

The rapid filter system of the Osaka Municipal waterworks at Kunishima is capable of filtering 96,000 cubic metres of water a day, with the filtering speed fixed at 120 metres per diem. Shown in the centre of this picture is the whole plant of this system, the construction of which is one of the salient features of the recent 4th extension work. The square white building on the extreme right is the main building where there are offices, stores, medical solution rooms, and water examination offices. The flat rectangular building in front of the main building the shed on both sides of which are the rapid filter beds, six each on one side in a row, covered with reinforced concrete lids. In front of this shed are the settling reservoirs, three in a row, and the small square partitions at the end of these settling reservoirs are the mixing chamber.

Natural Following and Pumping Systems

It depends largely upon the geographical conditions whether the system of natural following of water is adopted for taking in water at, and in leading the water from the water sources to the filteration plant, and from the latter to each individual consumer, or whether a pumping system is adopted all the way through or partially. Generally speaking, however, the method of natural following of the water is adopted at such systems which collect water at upper stream of rivers or reservoirs and lead the water for a long distance from the water source to the distribution areas, as evidenced in the cities of Yokohama, Kobe, Nagoya, Nagasaki, Shimonoseki, Utsunomiya, and elsewhere. Nevertheless, most of the waterworks which collect water from lower stream of rivers, deep wells, springs, and from horizontal gallery buried under the river-bed adopt the pumping system.



Mixing Chambers and Settling Reservoirs

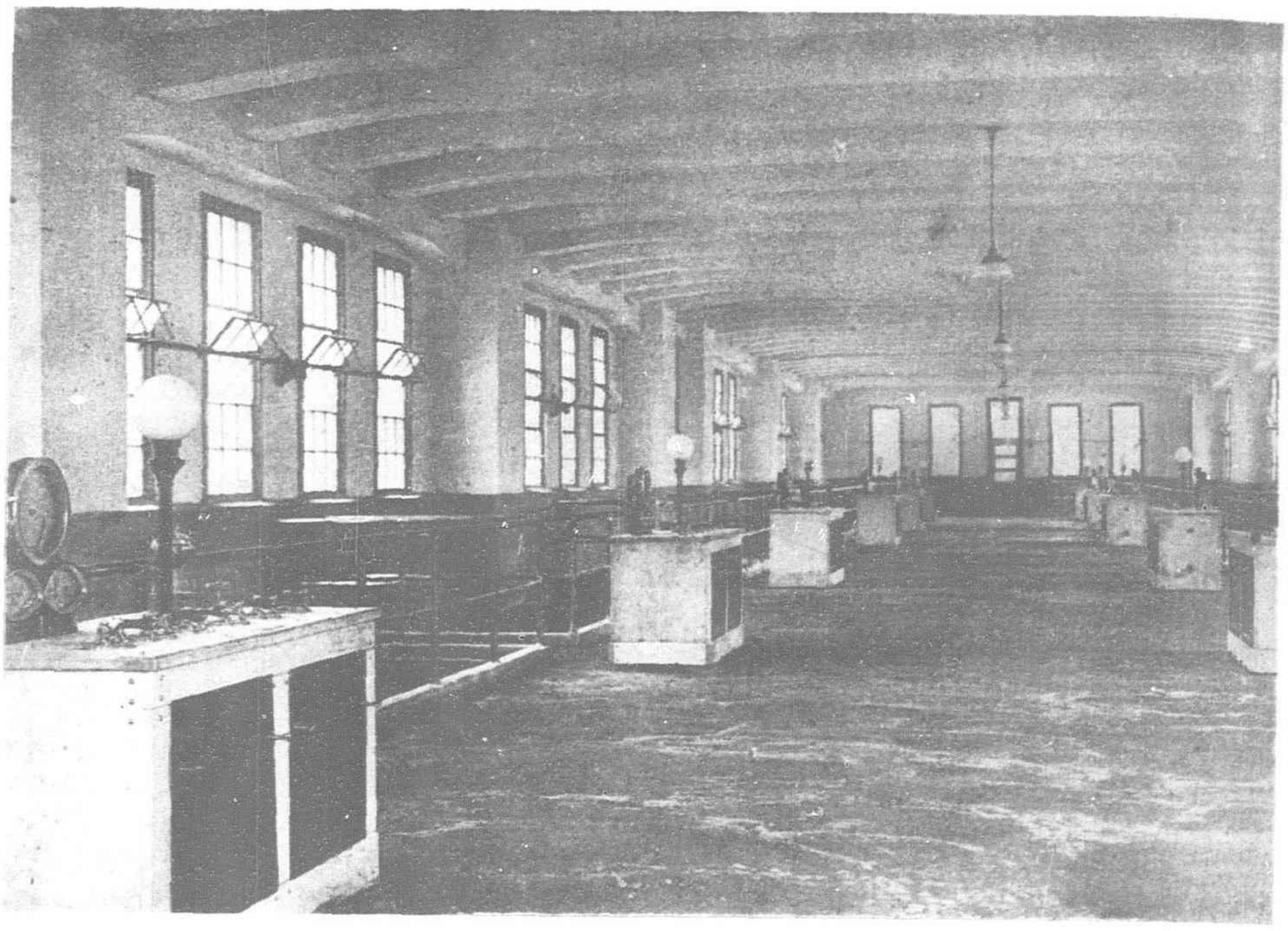
Part of the mixing chamber and the three settling reservoirs of the rapid filter system of the Osaka Municipal Waterworks are shown in this picture. Further up in this picture are seen the shed and the back view of the main building of the rapid filter system.

It naturally goes without saying that there are many waterworks where the pumping system is adopted only for taking in water at the water source and the other system is adopted for sending the water from the source to the filteration plant, or *vice versa*. In the distribution of clean water, however, the system of the natural following of water is adopted almost exclusively, for the sake of smooth running of undertaking. Even in such cities, the geographical conditions of which makes it difficult to build the distribution reservoir of clean water at an elevated place, the system of natural following of water is adopted by means of erecting the distribution tower. There are very few waterworks which distribute water to consumers by the direct pumping system, although this system is adopted in some part of Tokyo, the cities of Osaka, Saga and Takata. And, with exception of Tokyo and Osaka, the electric power is adopted for this purpose.

There are two kinds of regulation cast iron tubes which are widely in use for water mains. The one is that of the ordinary pressure, namely, water head 200 feet, the per square inch pressure,

86 lbs, and the other, is water head, 100 feet, the per square inch pressure, 43 lbs.

The cities, towns, villages, and business concerns which operate waterworks organized the Josui Kyogi-kai or the Waterworks Council in 1904, initiated by the city of Tokyo, with the object of studying various items concerning the waterworks in order to improve the system and help popularize the system. The members of this organization are not limited to those waterworks within Japan Proper, for, the Chosen Government, the Taiwan Government, the Japanese Government of the leased territory of Kuantung, and the South Manchuria Railway Company are the members. This organization holds an annual meeting each year at whatever the places by turn where there is a member. It considers various current topics concerning the waterworks at these annual meetings, and then, publishes statistics about the enterprise.



Inside View of the Rapid Filter System's Shed

Shown in this picture are the switches attached to each individual filter beds of the rapid filter system at the Osaka Municipal Waterworks, together with the indicators and the apparatus for examination of the filtered water. On both sides of this shed, there are twelve filter beds, six each on one side, which are covered with reinforced concrete lids. The filtering speed is always regulated automatically by operator of regulators which standardize the volume of water permitted to flow out of the beds, although the filtering speed can be fixed at 120 metres a day.

Y8,000,000 Extension Program Completed

It was as early as about 1880 that the establishment of waterworks was planned in Osaka, but the plan was not realized for some time because of various obstacles in the way. The City Assembly, however, approved the proposal in July, 1891, and the actual work of construction was commenced in August of the following year. Three years later, that is, in October, 1895, the first waterworks of Osaka, which was the fourth in Japan, was completed.

In those days, the water was taken in from the Yodo-gawa at Sakura-no-Miya, and a reservoir was constructed at the present site within the Osaka castle to accumulate clean water, which was then distributed in the city by the natural following of the water through inclined water mains that extended to nearly 200 miles. The cost of construction was Y.2,398,945.

With the continuous expansion of the city resulting from the rise of industry and commerce, the consumption of water also increased. It eventually necessitated the city authorities to enlarge the capacity of its waterworks. In fact, it has been extended three times already, and the fourth expansion work was completed in March, this year, at the cost of Y.8,000,000.

The construction of the Kunishima waterworks at Kunishima-machi, Higashi-Yodogawa-ku, Osaka city, by the western embankment of the New Yodo River, constitutes the second phase of extension work of the city waterworks. Having realized that they could no longer follow the rapid increase of water consumption by the fast growing populace of Osaka by mere "patch-up" extension of its original waterworks at Sakura-no-Miya, the city authorities decided to establish an altogether new waterworks at Kunishima, and distribute the water by service pumps. The plan was approved by the City Assembly in August, 1907, and it was carried out beginning in January of the following year.

After seven years' continuous work and disbursement of some Y.10,500,000, the Kunishima waterworks was completed in March, 1914, and subsequently, the operation of the Sakura-no-Miya waterworks was suspended in September, 1915, and then, it was altogether abolished in December, 1920. Almost immediately after the completion of the Kunishima waterworks a supplementary work was carried out at the cost of nearly Y.400,000, and its capacity amounted to 1,350,000 *koku* or 53,595,000 gallons, but this capacity was further extended by virtue of the third extension work to 2,100,000 *koku* or 83,370,000 gallons in March, 1922, spending about Y.10,404,000. And, in consequence of the fourth extension work, which has just been finished, the present capacity of the Kunishima waterworks has been enlarged to a maximum of 578,000 cubic metres or 127,040,000 gallons a day.

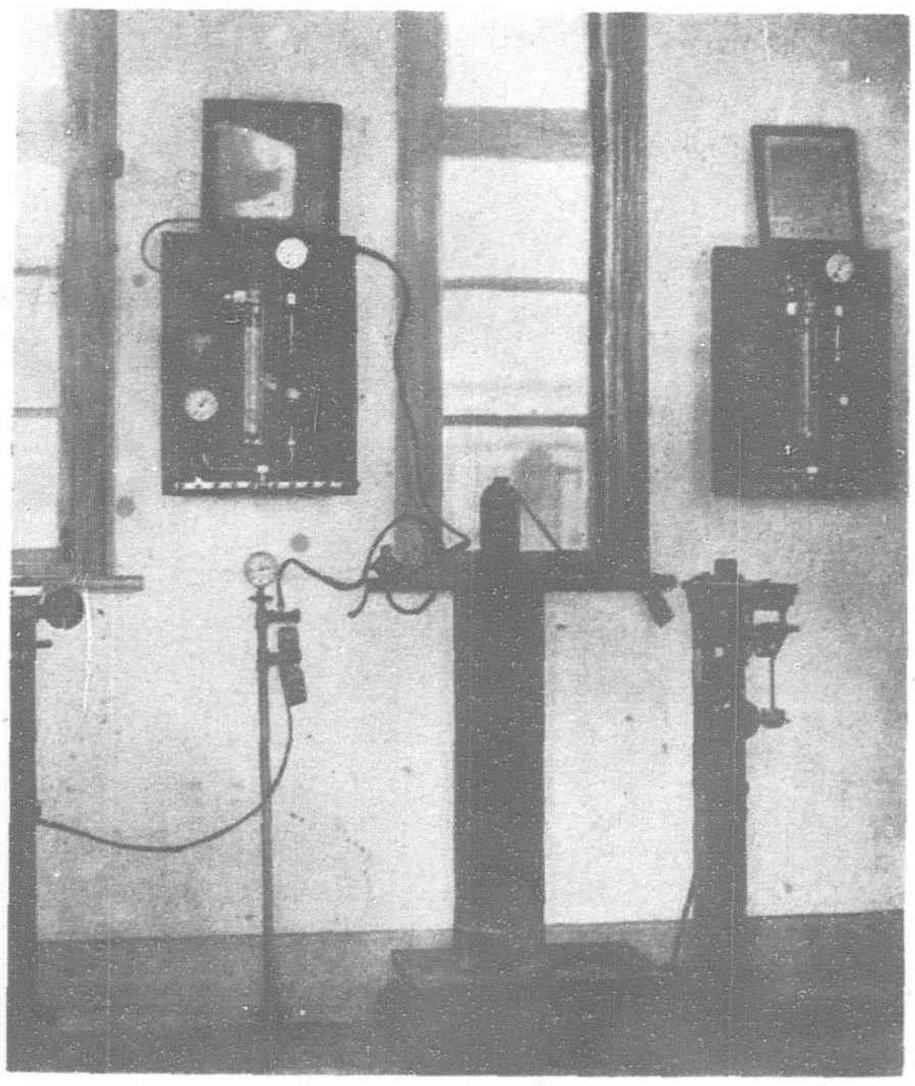
Included in its present equipment of the Kunishima waterworks are the following:

Three intake towers: two oval shaped brick buildings, 6.8 metres by 4.5 metres in diameters, and 15.2 metres in height; one round brick building, with a diameter of 5.5 metres, and 15.2 metres in height; one round brick building, with a diameter of 5.5 metres, and 15.2 metres in height.

Four grit chambers: two rectangle, reinforced concrete chambers, with a length of 45.5 metres, width, 10.9 metres, and depth, 3 metres, each; two lozenge pattern, reinforced conrete chambers, with a length of 39.4 metres, width, 12 metres in the center, and 6.1 metres at both ends, and depth, 4.2 metres, each.

Two intake pump stations: reinforced concrete buildings with the ground space of 130 *tsubo* and 148.6 *tsubo*. (One *tsubo* is six feet square or 36 square feet.)

Thirteen intake pumps: six centrifugal pumps directly connected with motors, with a capacity of 100 h.p. each, having revolutions, 600 per minute, pumping capacity, 2,100 cubic metre per hour, pumping water to a height of 8.5 metres; three centrifugal pumps directly connected with motors, with a capacity of 150 h.p. each, having revolutions, 600 per minute, pumping capacity, 3,000 cubic metres per hour, pumping water to a height of 8.5 metres; two centrifugal pumps directly connected with motors, with a capacity of 325 h.p. each, having revolutions, 600 per minute, pumping capacity of



Chlorination Room

4,900 cubic metres per hour, pumping water to a height of 12.2 metres ; two centrifugal pumps directly connected with motors, with a capacity of 250 h.p. each, having revolutions, 600 per minute, pumping capacity, 3,750 cubic metres, pumping water to a height of 12.2 metres.

Six intake mains : one cast iron main with a diameter of 1,140 milimetres and one reinforced concrete main of the identical diameter ; one cast iron main with a diameter of 1,070 milimetres and two wooden main of the identical diameter ; one cast iron main with a diameter of 1,220 milimetres.

Three sulphuric almina solution chambers : one wooden, two-storied building with a ground space of 15 *tsubo* ; two wooden, two-storied buildings with a ground space of 12.5 *tsubo* each.

Ten settling reservoirs : seven stone-walled concrete reservoirs with length, 102 metres, width, 78 metres, depth, 3.2 metres, and capacity 23,160 cubic metres each ; three reinforced concrete reservoirs, with similar measurements but a larger capacity of 25,160 cubic metres each.

Twenty-four filter beds : fourteen tile-faced concrete beds with length and width of 73 metres each, having filter speed of 4.84 metres, and a capacity of 25,440 cubic metres each a day ; ten reinforced concrete beds with the same measurements and capacity as the foregoing 14 beds.

Six clean water reservoirs : four rectangle concrete reservoirs with a length of 84 metres, width, 71 metres, and depth, 3 metres each, with a capacity of 16,000 cubic metres each ; two reinforced concrete reservoirs with a length of 73 metres, width, 71 metres, depth, three metres, each, with a capacity of 15,000 cubic metres each.

Two mixing chambers for rapid filter system : two mixing chambers of reinforced concrete, with a length of 58 metres, width, 3.4 metres, and depth of 5.2 metres, each.

Three settling reservoirs for rapid filter system : three reservoirs of reinforced concrete, with a length of 80.2 metres, 16.2 metres, and depth, 5 metres, each.

Twelve rapid filter beds : 12 rapid filter beds of reinforced concrete, with length of 11 metres, width, 8.5 metres, and depth, 3 metres, each. At the filter speed fixed at 120 metres a day, the capacity of each bed is 9,600 cubic metres a day.

One Rapid filter system shed : one-storied reinforced concrete building, the ground space occupying 183.9 *tsubo*.

Rapid filter system main building : one three-storied reinforced concrete building with a basement, the ground space extending to 80.5 *tsubo*, the floor space extending to 356 *tsubo* ; the basement is for the storage of sulphuric almina and other things, ground floor for the office, second floor for apparatus of solving sulphuric almina and the research office inspection of the quality of water, and the third floor for washing tank.

Three chlorination houses : two wooden buildings occupying the ground space of three *tsubo* each ; one wooden building, occupying the ground space of four *tsubo*.

Seven chlorination apparatuses : No. 1 room, equipped with two apparatus having a maximum capacity of chlorination amounting to 50 kilograms each a day, one of them being a reserve ; No. 2 room, equipped with three apparatus, two of which having a maximum capacity of 72 kilograms each a day, and the remaining one having a maximum capacity of 32 kilograms a day ; No. 3 room, equipped with two apparatus having a maximum capacity of 73 kilograms each a day.

Two service pump stations : one brick building, occupying a ground space of 604 *tsubo* ; one reinforced concrete building, extending to 267 *tsubo*.

Twenty-one service pumps : three centrifugal pumps directly connected with electric motors, the capacity of the motor being 280 h.p., revolution, 1,200 per minute, pumping capacity, 760 cubic metres per hour, and capacity of pumping water to a height of 61 metres ; twelve centrifugal pumps directly connected with electric motors, with the capacity of motor being 300 h.p., revolution, 1,200 per minute, pumping capacity, 1,010 cubic metres per hour, with the capacity of pumping water to a height of 55 metres ; six centrifugal pumps connected with steam turbines, the capacity of the turbine being 1,390 h.p., the revolution, 7,500 per minute, pumping revolution, 680 per minute, pumping capacity, 5,580 cubic metres per hour, and with the capacity of pumping water to a height of 55 metres.

One electric power receiving and transformation station : a brick building, occupying a ground space of 81.9 *tsubo*.

Equipment for receiving and transformation : station, No. 1 ; four 500 k.v.a. single phase transformer, one of these being a reserve : four 100 k.v.a. single phase transformer ; six 25 k.v.a. single phase transformer. Station, No. 2. three 2,000 k.v.a. single phase transformer, one of them being a reserve ; four 750 k.v.a. single phase transformer, one of them being a reserve ; six 25 k.v.a. single phase transformers.

Power generation plant : a brick building, occupying a ground space of 121.2 *tsubo*.

Equipment of the power plant : main generator : three triple vertical closed type directly connected with steam engine, with a capacity of 180 k.w. per hour each ; auxiliary generator ; two double vertical closed type directly connected with steam engines, with a capacity of 60 k.w. per hour each.

Boiler station : a brick building occupying a ground floor 521.7 *tsubo*, consisting of the boiler room, coal economizing room, blower rooms ; two chimneys having a top diameter of 2.73 metres and a height of 24.2 metres each.

Steam boilers and additional equipment : twelve super-heated steam boilers with heating area of 262 square metres each, and heater's area of 81 square metres each ; four saturation steam boilers with heating area extending to 262 square metres each ; one unit of coal conveyer ; four units of coal economizers ; four blowers ; one united of aerial coal conveyer with a capacity of 20,000 kilograms per hour.

Distribution mains : No. 1 service pump station : western main, diametre, 1,070 milimetres, goes across the New Yodo River, reaches Honjomachi, goes across the Aji River, passes the Hanazono bridge, and arrive at the harbor ; central main, diameter, 990 milimetres, goes across the New Yodo River underneath the river bed, reaches Umeda, goes across the Dojima River, and the Tosabori River, and runs along the Nishi-Yokobori River to Saiwaicho ; Horie main, diameter, 1,070 milimetres, goes across the New Yodo River underneath the river bed, reaches Nakatsu, runs along the Dojima-Ohashi (bridge), and arrives at Sakuragawa-machi ; Tamatsukuri main, diameter, 990 metres, goes across the New Yodo River underneath the river bed, reaches Toyosakicho, goes along the Miyakojima bridge, passes through Tamatsukuri, and ends at the western gate of the Tennoji temple ; Castle clean water reservoir main, diameter, 660 milimetres, goes across the New Yodo River underneath the river bed, runs along the Miyakojima bridge, and reaches the clean water reservoir within the Osaka castle site.

No. 2 service station : eastern main, diameter, 1,070 milimetres, goes across the New Yodo River, reaches Nagaramachi, arrives at Tenjinbashi Rokuchome, runs to south along Temmabashi street, reaches the west gate of the Tennoji Temple, and then goes still further south to Abeno way ; northern main, diameter, 990 milimetres, reaches Tenjinbashi Rokuchome same as the eastern main, but from there it goes to Deiri bridge via Ukitamachi and the Osaka station, then it goes to Sakurajima-machi *via* the Asahi bridge, Kishima-machi and Shimaya-machi.

Main Features of 4th Extension Program

It is amazing to note that the *per capita* consumption of water increases enormously ; to-day, it already exceeds one *koku* or 39.7 gallons (or 0.18 cubic metres) with an indication that it would further rise. The city authorities found in the summer of 1923 that the Municipal waterworks would be unable to meet the increasing demand for water in the summer of 1927. They drafted a plan which would cope with any growth of the city upon materialization of the Greater Osaka city construction plan, but as it takes fearfully many years to realize the permanent plan, they decided on the 4th extension plan to meet the immediate requirements.

The present extension work, which was started in 1925 upon the calculations that the maximum daily supply of water in 1936 might reach 3,200,000 *koku* or 578,000 cubic metres, consisted of increasing the filtering speed of existing filter beds at the Kunishima waterworks from 3.6 metres to 4.84 metres a day, thereby increasing the capacity by about 570,000 *koku* or 103,000 cubic metres, and also, of the construction of a rapid filter system within the present compound of the Kunishima waterworks to increase the capacity by 530,000 *koku* or 96,000 cubic metres ; with these two enterprises now completed, the city waterworks was enlarged by 1,100,000 *koku* or 199,000 cubic metres to the aggregate total capacity of 3,200,000 *koku* or 578,000 cubic metres.

It was as the result of careful experiments and investigations that the city authorities found that the filtering speed could be increased from 3.6 metres to 4.8 metres without affecting the quality of water. They also decided to build a rapid filter system in consideration of the fact that they can build it within about 3,800 *tsubo* of land in the present compound of the Kunishima waterworks without purchasing additional land for the site, and also, that they could save a considerable amount of the cost of construction. The area of the site required for the rapid filter system is about one-fifth of the site of ordinary, slow filter system.

In view of the fact that some new pumps of various purposes were to be newly installed in connection with the 4th extension work, the city authorities also availed themselves of this opportunity to replace some of the old ones and then lowered the bed of these pumps.

Included in the main items of the 4th extension program are the following :

1. Additional intake tower and grit chambers : in line with the two intake towers of the old system, a new intake tower, a round, brick building with a diameter of 5.5 metres and a height of 15.2 metres was built at a point about 30 metres lower stream. The bottom of this intake tower went into the river bed to a depth of 7.3 metres to take in water from underneath the river-bed through more than 500 small holes in order to reduce the burden of the filter bed at such times as when the running water of the river is muddy. Two new grit chambers of reinforced concrete, shaped lozenge pattern, were built beside the old grit chambers at their north ; each one of them had a length of 39.4 metres, with widths of 6 metres at the both ends, and 12 metres in the centre, having an effective depth of 4.2 metres.

2. Intake pumps and intake mains : Four additional intake pumps were installed, one of them being for a reserve purpose ; they are centrifugal pumps directly connected with electric motors, and two of them have a capacity of 3.750 cubic metres each, the other two of them having a capacity of 4,900 cubic metres, each. All of them have a capacity of pumping water to a height of 12.2 metres. Two intake mains, having a diameter of 1,220 milimetres each, were laid between the intake tower to the new grit chambers, and two more intake mains of the same size were laid from the grit chambers to the suction well within the intake pump station ; from the suction well, the water is led to old settling reservoirs and also to the new rapid filter system through two intake mains having a diameter of 1,220 milimetres and 1,070 milimetres, respectively.

Equipment for Increase of Filter Speed

Although the city authorities had discovered that they could safely increase the filter speed from 3.6 metres to 4.84 metres a day without affecting the quality of the filtered water, they enlarged and prolonged the waterway just the same to make it sure that the quality sustains no adverse effect, and in addition, they built the apparatus of mixing sulphuric almina at three places before the water enters the settling reservoirs, and also, the apparatus of chlorination at also three places after the water is filtered.

Rapid Filter System

The establishment of the rapid filter system consists of the construction of automatic medical mixing equipment, the mixing chambers, settling reservoirs, filter beds, buildings for the rapid filter system. The entire outfit of the system occupies a ground space of about 3,800 *tsubo*.

In the rapid filter system, a certain fixed quantity of sulphuric almina has to be mixed in proportion to the muddiness of the original water, and moreover, the nature of the water may require the mixing of a proper volume of lime, and therefore, an apparatus is built by operation of which the proper quantity of medicine is mixed automatically in proportion to the muddiness of the original water before it reaches the settling reservoirs.

The original water which is taken in at the intake pump station is led to the measurement will where the quantity is measured and a proper volume of medicine is added, and then, it is led to the mixing chambers.

At the mixing chamber, the medical solution and the original water are thoroughly mixed, while the water is permitted to flow at the speed of 15 centimetres per second ; there are two mixing chambers, each of them having a measurement of 3.4 metres by 58 metres with a depth of 5.2 metres. Both of these chambers have small partitions vertically submerged in the water at the right angle (90 degrees) to prevent the smooth running of the water, at a distance of every 1.2 metres, so that the way may flow above the top and underneath the bottom of these partition planks.

From the mixing chambers, the water is led to the settling reservoirs where the floating objects settle down. There are three of them in a row, each one of them having a measurement of 16.2 metres by 80.2 metres with an effective depth of 5 metres. When the flowing speed is fixed at one foot per second, it corresponds to the settling for four hours and a quarter.

Both the mixing chambers and the settling reservoirs are made with reinforced concrete with asphalt bed and clay walls.

There are 12 filter-beds running in a row, two abreast, on both sides of the filter-bed shed which is a reinforced concrete, one-storied building of about six metres wide and almost 60 metres long. All of these beds are covered with reinforced-concrete lids to prevent the water from freezing and also to prevent any dirt falling into them. Of the twelve of these, 10 of them are in use, the remaining two being reserves.

Each one of these filter beds has an effective width of 8.5 metres, a length of 11 metres, and the total depth of 5.5 metres ; they have double bottoms, the upper bottom being made up of sand and gravel strata of 76 centimetres and 36 centimetres thick, respectively. The filtered water, then, goes through funnel-shaped water collecting devices into the pressure-water room underneath, this room having a depth of 76 centimetres. All the valves leading out of this pressure-water room are operated by water-pressure switches, and each bed has an individual switch which is coupled with indicators and apparatus of pumping up small quantity of water for examination.

The filtering speed is about 120 metres a day. The outflowing tubes of each filter bed is equipped with regulator by means of which the filtering speed is always regulated at a certain fixed standard and it automatically regulates the quantity of water flowing out of these tubes. The filter beds are washed with clean water led from the water tank on the roof of the main building of the rapid filter system ; the water is led into the pressure-water room beneath the filter bed, and forced into the filter bed through the funnel-shaped water collecting device just in reverse action as the water led from the mixing chamber and settling reservoirs is filtered. The water used for washing the filter bed is accumulated at a used water pond and discharged into neighboring drains *via* water pipe.

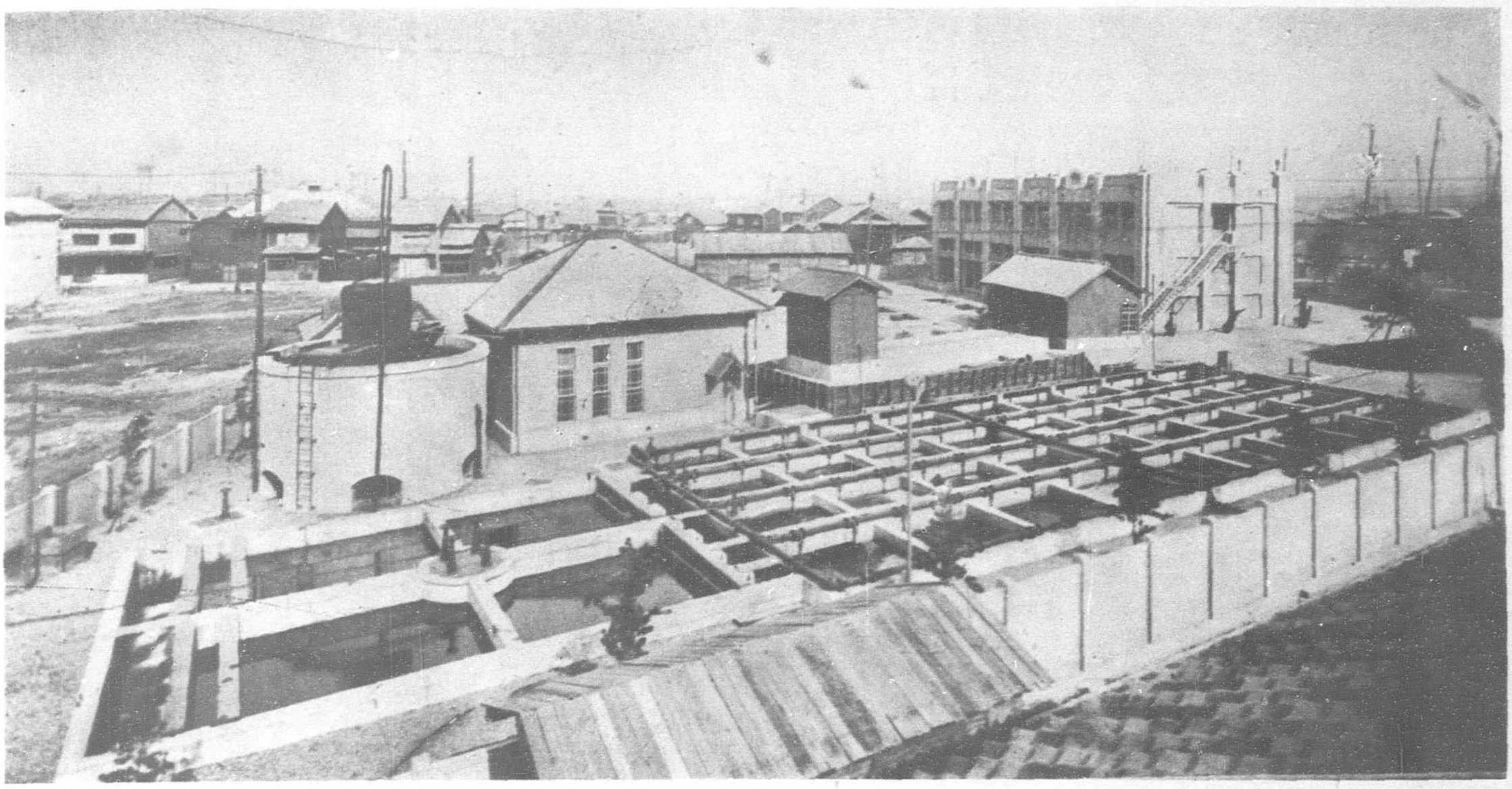
Canadian Pacific Liner Converts Heating System

The Canadian Pacific liner *Montcalm* recently had her entire heating system overhauled while laid up in Liverpool. She has been equipped throughout with the Dunham vacuum system of heating, which system has already been fitted on her sister ships, the *Montclare* and *Montrose*.

Most of the original steam piping was used in the conversion work, but the two lines of piping were separated entirely, becoming one line to feed the radiators and one to return the condensate, each radiator being fitted with a Dunham thermostatic trap. The return piping led the condensate back to the engine room and was connected up directly to a Dunham electrically-driven vacuum pump, which returned the condensate at high temperature to the drain tank or hotwell. The initial steam pressure for the heating service was reduced to 5 lbs. per square inch, while the vacuum pump creates 15-in. vacuum without the aid of cooling water or condenser.

The accommodation heating was separated entirely from the thermotank and galley services, all of which had previously been fed from the same steam line. All the steam fixtures in the galleys and pantries were fitted with medium pressure traps, and this system was operated independently at a pressure of 25 lbs. per square inch instead of 50 lbs. as before. It was found on test that boiling in the galleys and pantries could be carried out more rapidly than before the alterations were effected, with the additional advantage of individual control for simmering, etc.

The four " Duchess " vessels belong to the same line are now heated by the Dunham vacuum system, while the same system has been selected for the *Empress of Britain* and *Empress of Japan*.



General View of the Ichioka Experimental Plant

The experimental activated-sludge sewage disposal plant at Ichioka, Osaka, has a capacity of treating 172,000 cubic feet of sewage and excreta per day on the average, it covering a neighboring population of 26,000. In this picture is shown the whole plant. Behind the building in the center with three windows, part of the grit chamber is seen ; the raw sewage goes through the first stage of treatment there. Then, it comes to the aeration tank, shown front, on the right, which is sub-divided into many parts. From this tank, the sewage flows into the settling tank, front, left, which is divided into two parts, though it appears as though it is divided into four parts. The cleansed water on the top is permitted to flow into a neighboring river, while the sludge that settles down at the bottom of this tank is pumped into the sludge tank, the cylinderical building on the left, where the sewage goes through the final stage of the treatment. The small building beyond the aeration tank with a small black house at the edge is the excreta tank.

Osaka to Build Modern Sewage System

Experimental Activated-Sludge Sewage Disposal Plant at Ichioka, Osaka, Satisfactory

By EISABURO KUSANO

THE city of Osaka, one of the most thriving industrial and commercial centers of Japan, proposes to build two activated-sludge sewage disposal plants within the city at an estimated total cost of Y.17,000,000 as a six year program which is to begin in the near future. Of these, the one that is to be established at Tsumori is to cover an area of 1,406 hectares in the central part of the city, the population in this locality being 737,000 ; the other, which is to be erected at Ebie, is to cover an area of 1,006 hectares in the northern parts of the city now inhabited by 451,000 people. The Tsumori and Ebie plants will have a site of 58,700 square meters and 30,600 square meters respectively. When these are established, the city will build three more of them now known as the Fukumachi, the Nakahama, and the Yamotogawa plants, as they are provided in the city construction plan. Upon completion, the entire system is to have the combined capacity of covering a maximum population of 5,000,000.

Plans of the Tsumori and Ebie activated-sludge sewage disposal plants are now being drawn up by the city authorities on the basis of what has been discovered as the result of various experiments conducted at the experimental plant which has been in operation since 1925 at Ichioka, in the southern part of the city.

Primarily, the city of Osaka is flat geographically with the exception of the eastern uptown end where it is elevated. In the flat and lower parts of the city, there run many branch streams of the Yodo-gawa and canals in all directions, eventually emptying into Osaka Bay in the Southwest.

Under these peculiar geographical conditions, a heavy rain fall invariably meant an inundation of the streets with all the ditches overflowing their banks some 30 years ago when there existed no sewage system in the city. Furthermore, the sewage was permitted to pour into neighboring rivers and canals, and it necessarily contaminated the quality of the water flowing in these streams. In the dry summer days, when the dirty water remained still, these streams were rendered the breeding places of all kinds of epidemics. It was after appalling cases of cholera had broken out and spread in this city in 1888 and 1890 that the people of Osaka fully realized the urgent need of building a sewage system.

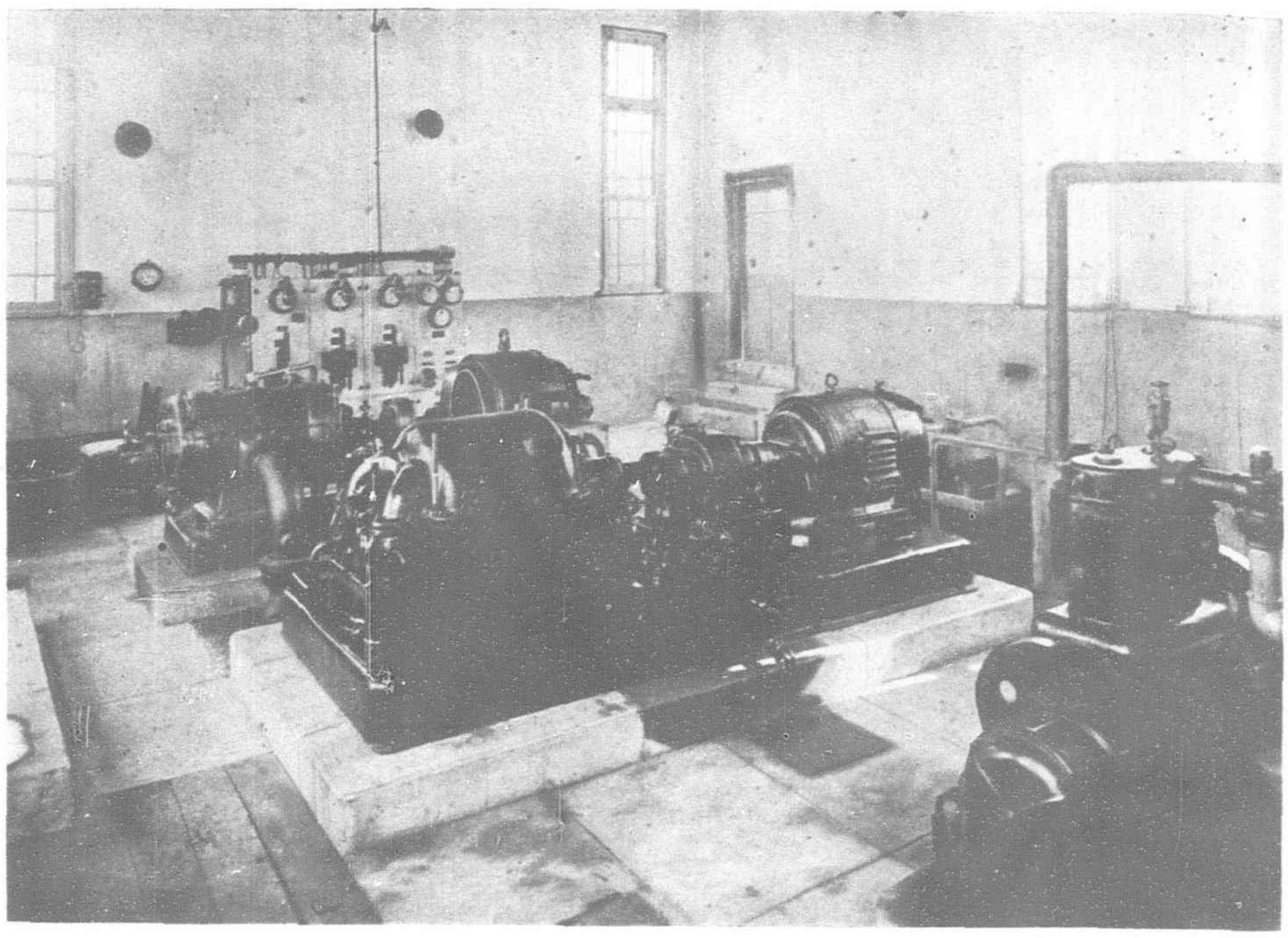
The Municipal Assembly of Osaka, in 1893, approved a five-year program of a general improvement of the ditches that existed in those days and also an introduction of a simple sewage system in the central parts of the city. The plan was put into effect in 1894 and it was duly completed. In 1909, it was also decided that a similar sewage system be established in other parts of the city as well. Following the amalgamation of Higashinari-gun and Nishinari-gun (a "gun" corresponds to county) with Osaka on April 1, 1925, it was decided that the new city, especially the densely populated districts, should also have the system, and the plan is now being carried out, work having begun in April, 1928, as a 10 year program. Thus the city is now fairly well equipped with a simple sewage system.

Nevertheless, the foregoing system drains only the rain water and domestic sewage without any purifying facilities. The sewage, therefore, pours into rivers and canals *via* sewage mains, although in some parts of the city it is allowed to settle and rubbish is removed before it is permitted to flow into the rivers. Because of this lack of purifying facilities, the contamination of the water flowing in rivers and canals has hardly been improved to any appreciable extent ; the effluvia as well as the impurity of the sewage cannot be removed by such a simple system. The fact that the level of

city is low and that the locality is dampish makes the situation still worse, especially in the newly added parts. Furthermore, the rapid industrial development of the city with the subsequent increase of factories and the quick expansion of the population has intensified the turbidity and impurity of the sewage to a large measure. As for the disposal of the excreta, hardly any improvement has been made generally, although in large buildings the modern flush toilet system is installed.

The city's sanitation facilities, in the circumstances, may be described as anything but satisfactory so far, in spite of the fact that much has been accomplished in the way of improving the situation, such measures including the constant betterment of the existing simple sewage system, the extension of the city's water works, and the construction of movable weirs at various points of vantage to increase the flowing quantity of the water in minor branch streams and canals in the city.

It was in consideration of the foregoing appalling situation that the Municipality has finally decided to build activated-sludge sewage disposal plants at five places in the city. Before the Municipal authorities arrived at this decision in March, 1928, however, it was found necessary that a thorough-going experiment of the activated-sludge sewage disposal system be conducted on such points as the general arrangement of the plant and the actual operation thereof dealing with the peculiar composition and turbidity of the sewage in Osaka at its different stages of density. Hence the construction of an experimental activated-sludge sewage disposal plant at Ichioka by the Shirinashi-gawa ; the construction started in November, 1924, and was completed in June, 1925, the cost of construction amounting to Y.127,400.



Interior of Machinery House: In this Building are Installed Two Sets of Air Compressors, Two Sets of Sludge Pumps and a Vacuum Pump

Experimental Plant at Ichioka

An area extending to about 92 hectares inhabited by 26,000 people in the Ichioka drainage district constitute the territory covered by the Ichioka Experimental Activated-Sludge Sewage Disposal Plant. Its capacity is fixed at two cubic feet per second, which can be increased three cubic feet in rainy weather when the sewage is diluted, on the basis of a calculation that the *per capita* quantity of sewage in fine weather amounts to six cubic feet per diem on the average, or 171,600 cubic feet in the aggregate total.

As is found in other methods of sewage disposal, the Ichioka experimental plant has such an arrangement that the raw sewage passess through the grit chamber and screens as the preliminary procedure, and then it is led into the aeration tank, which is equipped with diffusers, and the settling tank where the cleansed water is led out by effluent pipes into the Shirinashi-gawa (river) while the sludge that settled down at the bottom of this tank is sent to the sludge tank for re-settlement, thence to the re-aeration tank, meanwhile the surplus sludge is disposed of as such, separately. The details of the arrangement is as follows :

(*a*) Grit Chamber and Screens : the raw sewage is first led into the grit chamber and goes through a coarse and a fine screens in order that various floating objects, sand, pebbles and other hard rubbish are removed. The grit chamber has a measurement of 90 feet by 40 feet with a depth of 10 feet at the deepest spot. Of the total depth, three feet at the bottom is for settling of the rubbish.

(*b*) Sewage pump : the sewage that has passed the grit chamber is pumped into the influent channel that leads to the aeration tank. There are two sets of double-suction centrifugal pumps that are directly connected with 10 h.p. motors ; each one of the pumps is equipped with two pipes with a diameter of 10 inches each for suction and drainage, its capacity being two cubic feet per second (three cubic feet at maximum). The one is used and the other is for the reserve.

(*c*) Mixing chamber : the mixing of the activated-sludge is the cardinal principle of the present system. Its percentage is about 25 per cent. of the total quantity of sewage to be disposed of, with the water contained in the sludge being fixed at 98 per cent. The activated-sludge is pumped into this chamber from the re-aeration tank by sludge air lift (or by the sludge pump) and it is thoroughly mixed with the sewage that is pumped into this chamber from the grit chamber, and then, it is permitted to flow into the aeration tank.

The measurement of the mixing chamber is 35 feet by four feet, with a depth of five feet. It has diffusers at the bottom, same as in the aeration tank.

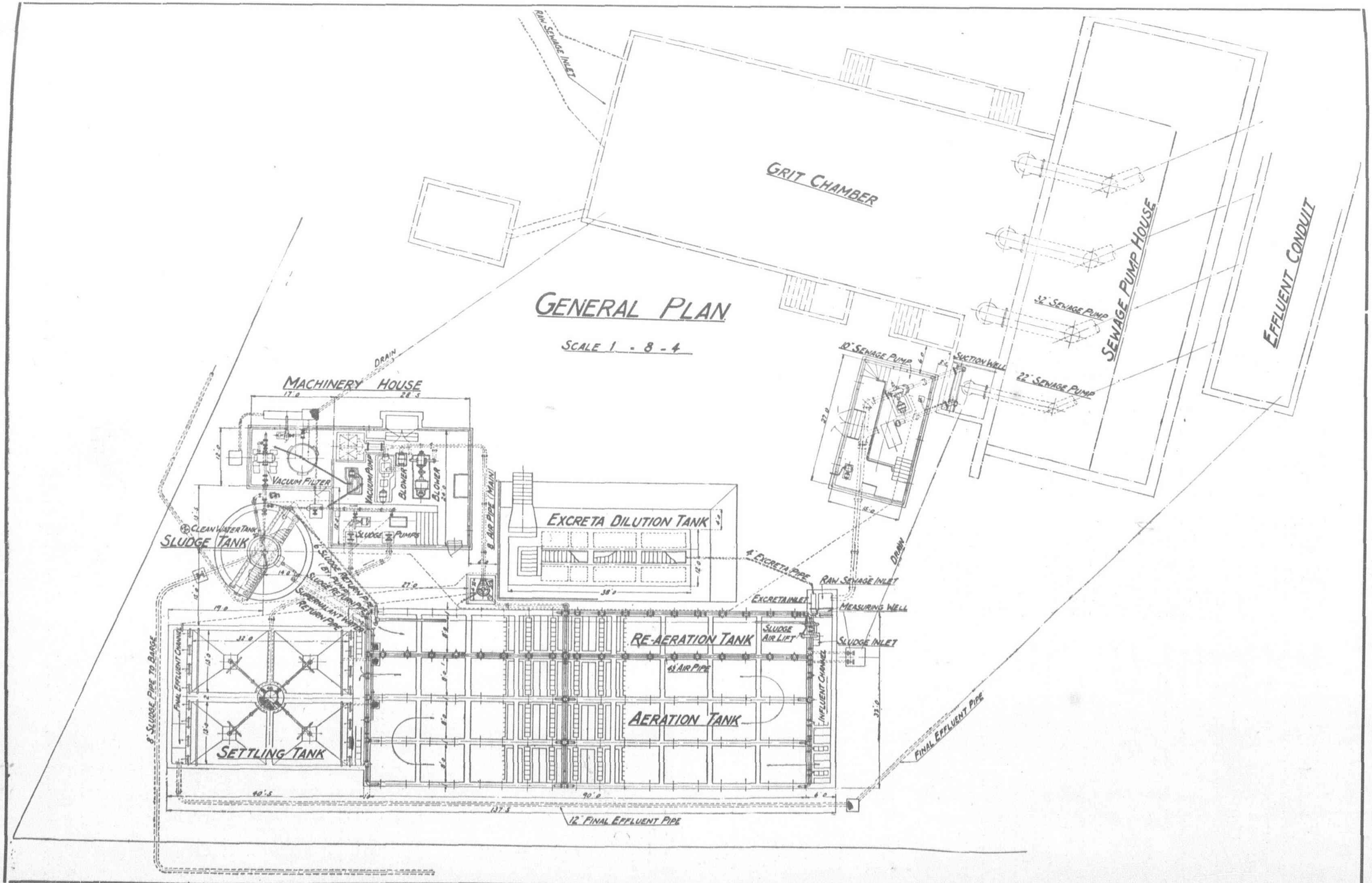
It also has an equipment of mixing an appropriate quantity of diluted excreta with the sewage pumped into this chamber from the grit chamber. This is for the purpose of carrying out various experiments of dealing with excreta, in view of the fact that the excreta are going to be permitted into the sewage mains in the future directly from each home in the city.

(*d*) Aeration tank : this tank constitutes one of the most important parts of the whole system. It has a depth of 13 feet, with a length of 26 feet and breadth, five feet. It is divided by two partitions in parallel in order that a circuit waterway extending to 270 feet may be formed. At the bottom of the waterway, there are diffusers in the shape of an inverted V at the right angle to the flowing water. The diffusers are made of artificial stone of $1\frac{1}{2}$ inch thick, its surface extending to about one-sixth of the surface space of the flowing water. The capacity of the tank is about 28,000 cubic feet.

While the sewage runs through this aeration tank continuously, it undergoes the process of aeration by the air that is sent in microscopically through the diffusers. At the time of fine weather, the aeration lasts for about three hours, the quantity of air to which the sewage is aerated being about five cubic feet per one cubic feet of sewage, that is, about 0.7 cubic feet of air per gallon of sewage. The pressure is 7 lbs. on the diffusers. As regards the diluted sewage in the rainy weather, it is permitted to pour into the aeration tank at the rate of three cubic feet per second, and the aeration hours are reduced to two hours.

(*e*) Settling Tank : in view of the fact that the sewage which passes through the aeration tank still contains from 0.2 to 0.6 per cent of hard objects, it is led to the settling tanks which consist of two rectangle tanks with a measurement of 13 feet by 32 feet ; the bottom of each tank is in the shape of two each of inverted pyramids at the angle of 65 degrees to the water level. There is a sludge suction pipe with a diameter of four inches at the deepest part of the tank, which is 20.5 feet below.

Each one of these tanks has a capacity of about 5,200 cubic feet each. The sewage is led into this tank from the aeration tank through notches, and it is permitted to remain here for settlement for one hour and a quarter when the weather is fine, and 50 minutes when it rains. The sludge contained in the sewage completely sinks down to the bottom during this period while the clear water



EXPERIMENTAL ACTIVATED-SLUDGE SEWAGE DISPOSAL PLANT AT OSAKA, JAPAN

General Plan Showing Process of Treatment

In this general plan of the Ichioka experimental plant, the raw sewage is settled and screened at the grit chamber, then it goes to the mixing chamber, thence to the aeration tank and to the settling tank where the cleansed water is pumped out to a neighbouring river while the sludge that settles down at the bottom of this settling tank is pumped into the sludge tank for resettlement. The sludge that settles down at the sludge tank is sent back to the re-aeration tank in order that it may be mixed with raw sewage again, while the surplus sludge is disposed of seperately. It also shows the excreta dilution tank where the excreta is diluted by about 10 times as much before it is permitted to flow into the mixing chamber.

at the top is permitted to flow out of the tank through notches to effluent conduit and eventually to the Shirinashi-gawa (river). And also, near the entrance of this tank, there is a partition that is fixed at right angle to the direction of the water in order to prevent the smooth flowing so that the settling effect may be improved.

(*f*) Sludge tank : the sludge that settles down in the settling tank is pumped into this tank through the sludge suction pipe by the sludge pump to let it repeat the process of further settlement, and the dense part of it at the bottom is sent back to the re-aeration tank by two six-inch sludge return pipes as activated-sludge ; the volume of the activated-sludge to be returned to the re-aeration tank is measured so that only required amount of it may be sent there, while the surplus sludge is to be disposed of as such, separately.

This sludge tank is in the shape of a cylinder with an inner diameter of 18 feet. Its bottom is shaped like a funnel that inclines at 30 degrees to the water level, and it is equipped with a sludge raking apparatus which has two sets of Alchemedes-spiral blades.

The depth of the tank is 11 feet at the center, and six feet at the edges, the capacity being about 1,950 cubic feet. The quantity of sludge produced, excluding that which is returned to the re-aeration tank, amounts to about 1,700 cubic feet per diem, estimating the quantity of water implied in the sewage treated at 98 per cent.

(*g*) Re-aeration tank : side by side with the aeration tank, there is the re-aeration tank where the sludge that comes from the sludge tank is re-aerated before it is mixed with raw sewage. The measurement of this tank is eight feet by 90 feet, with a depth of 13.5 feet. At the bottom, there are diffusers same as in the aeration tank. Three hours are the standard for re-aeration. The reaerated sludge is poured into the flow of raw sewage through two air-lift pipes which have a diameter of five inches each.

(*h*). Excreta tank : this is a rectangle tank with a measurement of 10 feet by 30 feet with an effective depth of five feet, the contents being 1,500 cubic feet. The quantity of excreta turned out by a population of 26,000 in the district covered by this experimental plant is estimated at about 733 cubic feet per day. It is transported to this tank where it is diluted with water by about 10 times as much, and it is permitted to flow into the sewage mixing chamber at the rate of five cubic feet per minute by the natural following of the water. The excreta is poured into this tank through a special inlet which is three feet wide by six feet long, and there is a screen to prevent any hard object to go into the tank.

(*i*) Sludge pumps and air compressers : there are two pumps to pump out the sludge that settles at the bottom of the sludge tank, but only one is in use, the other being in reserve. The pump has two pipes each, namely, the suction pipe with a diameter of six inches, and the drainage pipe with a diameter of five inches, the capacity being 40 cubic feet per minute. They are of the centrifugal type, directly connected with 3.5 h.p. motors.

The air compressors now in operation at this plant can be regulated in such a manner that the volume of compressed air, as well as the intensity of the compression, can be controlled in whatever the way required in accordance with the nature and quantity of sewage to be disposed of. At present there are two ; the one is a turbo-air compressor, directly connected with a 58 h.p. motor, and the other is a centrifugal type one, also directly connected with a 49 h.p. motor. The former is used, and the latter is in reserve. As regards the capacity, the turbine type apparatus can produce from 270 to 900 cubic feet of air, compressed at the maximum intensity of 8.5 lbs, while the centrifugal type apparatus can produce 750 cubic feet, at the maximum compression of 10 lbs. These apparatus are equipped with special devices by means of which dust and oil are prevented from mixing into the compressed air, lest such rubbish may shut up the pores of the diffusers.

(*j*) Air pipes : Two cast iron pipes with inside diameters of eight inches and six inches, respectively, constitute the main air pipes. Gas pipes with inside diameter of 4.5 inches are used as branch pipes and the pipes that finally reach the diffusers are lead-covered gas pipes with an inside diameter of 1.5 inches which yoke out from these branch pipes. There are air controlling valves at each one of the junctions of these pipes so that the volume of air may be regulated according to the needs.

(*k*). Pump house and machinery plant : the pump house is one-storied wooden building covering a space of 11 *tsubo* (one *tsubo* equals six square feet) and two sewage pumps are installed in this building. The machinery plant is also one-storied wooden building, occupying about 20 *tsubo*, and two air compressors, two sludge pumps, and one vacuum pump directly connected with a 5 h.p. motor, the last mentioned pump being for disposal of the surplus sludge.

(*l*) Disposal of surplus sludge : the volume of surplus sludge turned out at this experimental plant amounts to about 1,700 cubic feet. This is valuable as fertilizer but it is difficult to handle because of the high percentage of water implied in it, and therefore, it is thrown away at present ; the surplus sludge is poured into a barge through a cast-iron pipe (inside diameter, eight inches) and the barge is then towed by a motorship, equipped with a 20 h.p. heavy oil motor, far out of Osaka Bay where the surplus sludge is thrown into the sea.

Nevertheless, various experiments of dehydrating the surplus sludge is also conducted at this experimental plant. There is a set of vacuum filter, operated by a 2 h.p. motor, a vacuum pump connected with a 5 h.p. motor, and also a water tank, to carry out the experiments.

Cost of Construction and Running Expenditures

The cost of construction of the experimental activated sludge sewage disposal at Ichioka amounted to Y.127,400 excluding the price paid for the site extending to 500 *tsubo*. When allotted to the population of 26,000 covered by this plant, the *per capita* cost of construction amounts to Y.4.95. And, in view of the fact that this plant has a capacity of treating 172,000 cubic feet of sewage and excreta per day, the cost of construction per each 100,000 cubic feet disposed of a day amounts to about Y.74,000.

Main items of the disbursements made in connection with the construction of this plant are as follows :

A set of purifying equipment, including the aeration tank, settling tank, and re-aeration tank	Y.52,778
A set of excreta tank	2,975
A set of sludge tank	5,773
Four centrifugal pumps directly connected with motors, including two sludge pumps, and two sewage pumps, and also, the cost of installation	7,876
Two Air compressors, including the cost of installation	24,710
Machinery house	6,695
Sewage pump house	2,674
A set of electric equipment	6,269
Water equipment, including water tank for sludge pump operation, water pipes, etc...	2,120
Dehydration equipment, including the vacuum filter and vacuum pump, and the cost of installation thereof	2,921
Surplus sludge conveying pipe	2,003
Tug boat, equipped with a 20 h.p. motor ..	6,620
Sludge transporting barge	1,930
Miscellaneous expenditures	2,050
Total	127,400

(Note : Slight difference in the total cost of construction given above is due to the fact that figures under one yen is omitted in the foregoing table.)

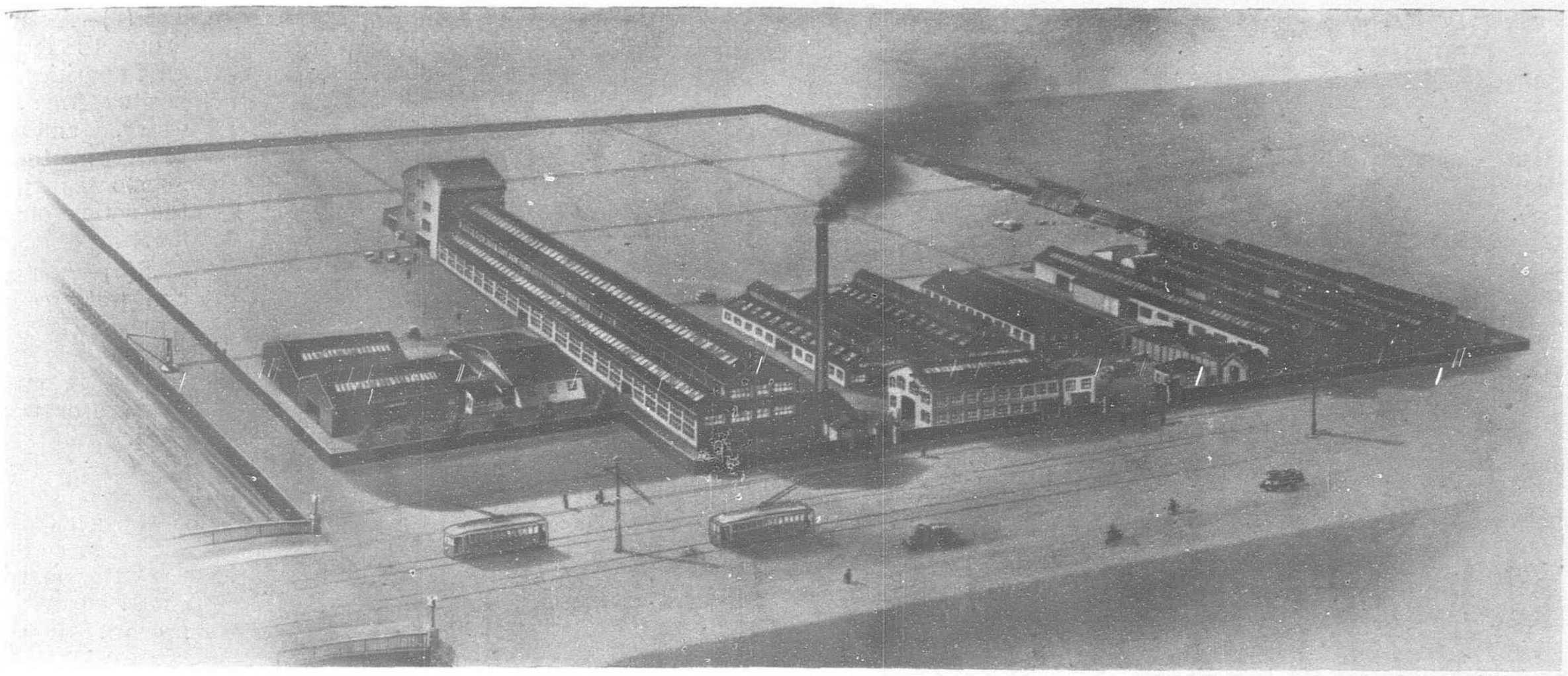
The daily cost of operation of this experimental plant amounts to Y.56.20 on the average, it running up to about Y.20,513 a year. When the foregoing total cost of operation is allotted to the population covered by the plant, the *per capita* cost of operation amounts to about Y.0.79 a year, and when it is allotted to the volume of sewage treated here, the cost of operation is about Y.0.32 per 100,000 cubic feet. The foregoing cost of operation, however, is that when all the surplus sludge is thrown into the sea, transported by a barge out of Osaka Bay.

Experiments Satisfactory

Primarily, the activated-sludge sewage disposal system was started and experimented in various large cities in Europe and America since 1913 with satisfactory results.

Since the establishment of the present experimental plant at Ichioka, various experiments have been conducted since January,

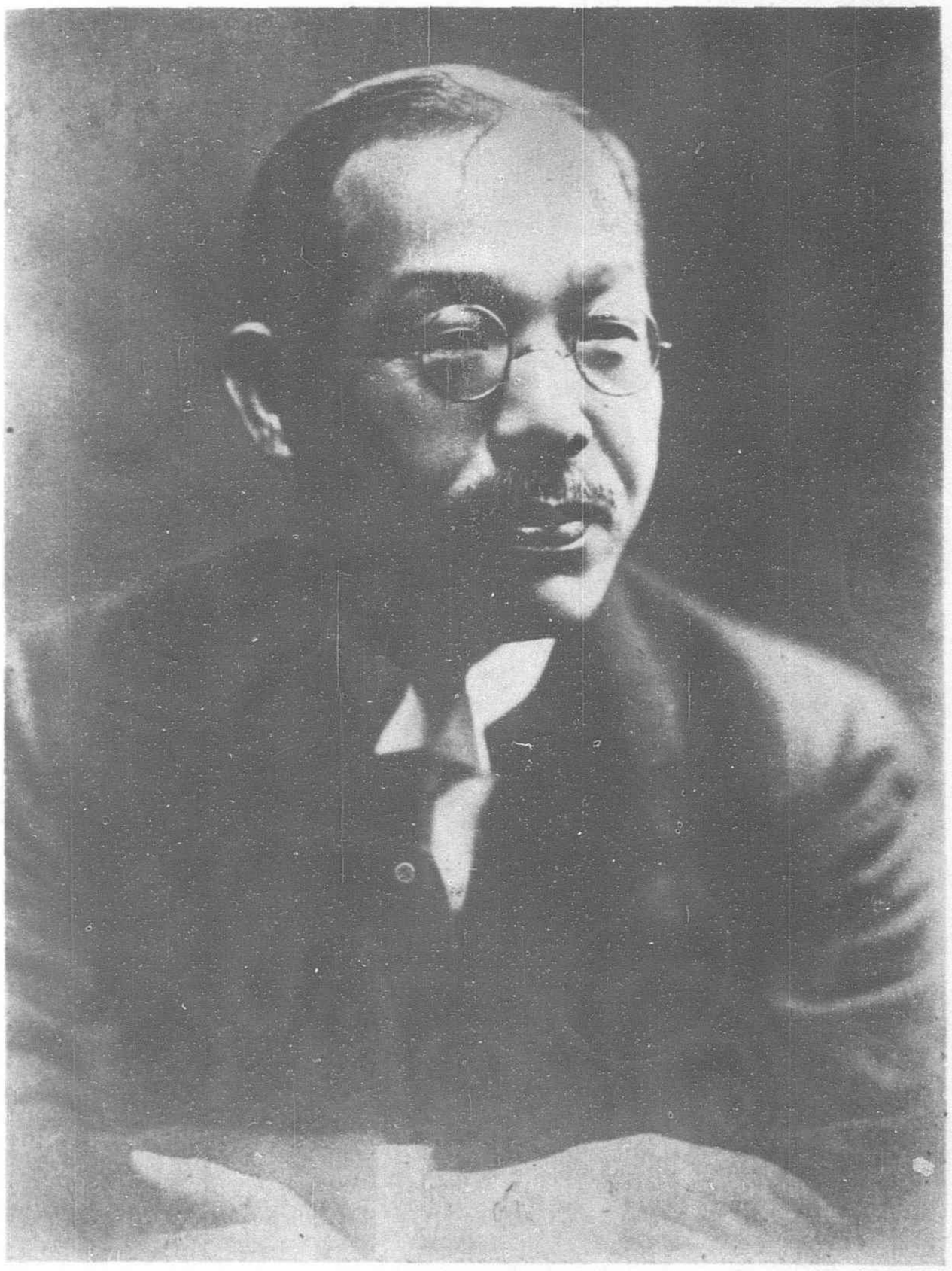
(Continued on page 432).



Works of the Toyo-Babcock, Yokohama

The Toyo-Babcock; An Anglo-Japanese Undertaking

It has not generally been known in the Far East that Messrs. Babcock & Wilcox, Ltd. of Babcock House, Farringdon Street, London, have been operating a branch works in Yokohama, Japan, employing over 500 men for nearly 20 years. This subsidiary undertaking was originally established under the company laws of Japan in 1908, the object at that time being to render prompt service to the Company's numerous clientele by expeditiously manufacturing common castings and other boiler and stoker parts, also effecting repairs and replacements with a minimum delay. In addition large stocks of pressure parts were kept on hand the result being that Babcock & Wilcox boiler users have always been able to keep their plants working without the loss of time connected with importing replacements from the home works in Renfrew. During the world war this Japanese branch works rendered an excellent account of themselves as they manufactured a much larger proportion of the company's specialities and thus were able to considerably relieve the home works in Renfrew, Scotland, who were more than overburdened with Admiralty and other munition work.

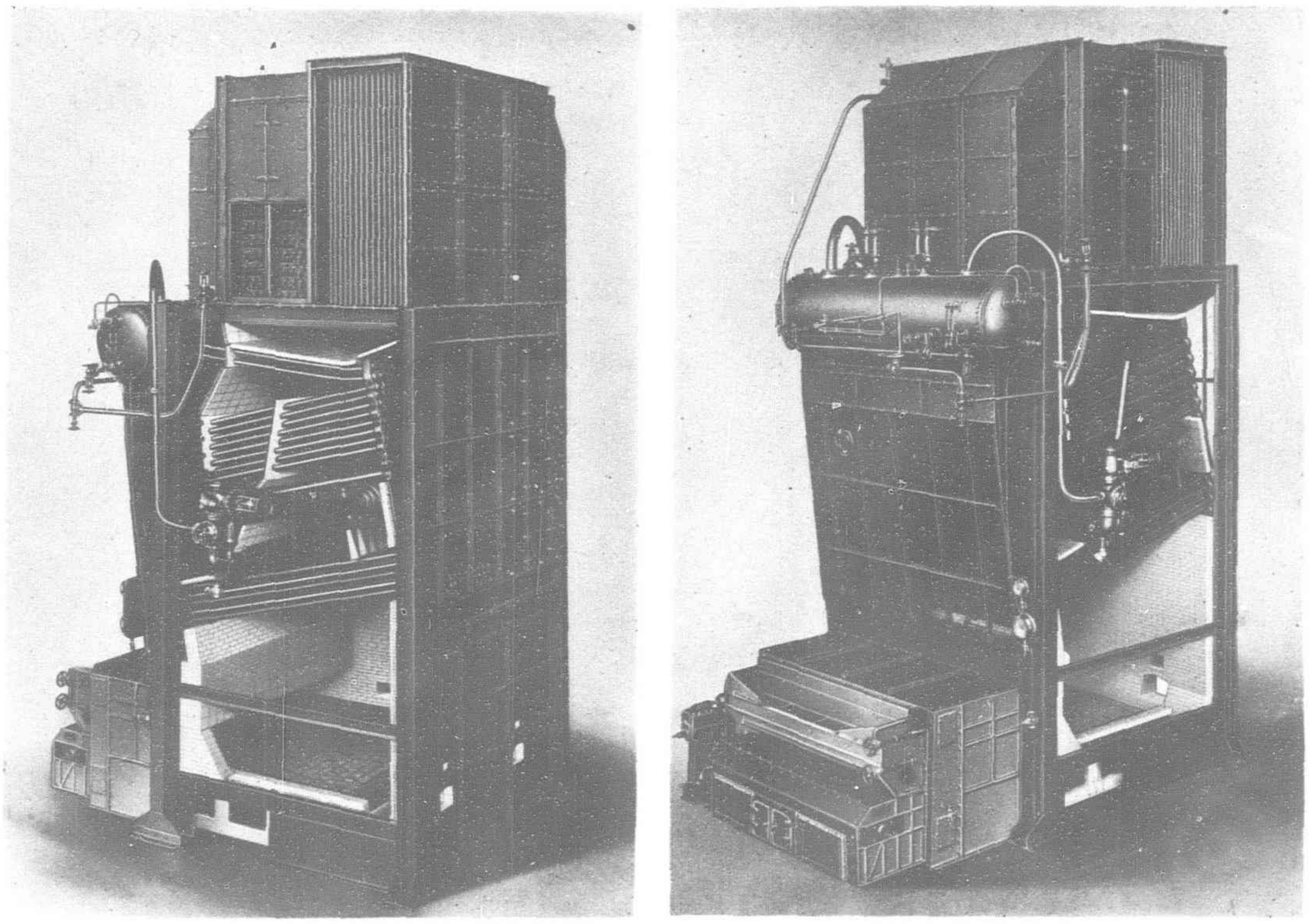


K. Nanjo, Esq., President of Toyo-Babcock, Limited

In December 1927 it was decided to consolidate Babcock & Wilcox's interests in Japan by combining the Japan works and their branch sales offices in the principal cities into one company under the name of Toyo Babcock Kabushiki Kaisha (Oriental Babcock Limited). Mitsui Bussan Kaisha who had been working closely with Babcock & Wilcox Ltd., for well over 20 years were asked to take up a share of the capital which at present totals Y.1,750,000. Mr. K. Nanjo is the President of the Company, S. Toba and J. Inouye, director and auditor respectively. The works are managed by Mr. H. Miyoshi who is also a Director of the company. A number of foreign technical advisers have been appointed by Bacbock & Wilcox to supervise technical matters, and it is confidently expected that the quality of the company's manufactures will not be below the high standard adhered to in the past.

The company have recently purchased additional land adjoining the original works at Isogo-machi on the outskirts of the Yokohama City, thus bringing the total land holdings up to over 10 acres with good canal and transport facilities adjoining

the property. New buildings and additional plant are being erected and installed including a complete Hydraulic plant suitable for making steam boiler drums for the highest pressures. The works has its own iron foundry making all kinds of castings from the raw materials. Other departments including a well equipped machine shop enables the company to produce all classes of Power House accessories, such as coal crushers, conveyors, cranes, etc., etc.



Sectional View of Modern C.T.M. Boiler

This new organization operated with combined Japanese and English capital will receive the full benefit of the parent company's vast experience in Europe, America and the rest of the steam using world in designing and manufacturing water tube boilers, steam appliances and power house specialities. Recently a new chain grate stoker for operating under forced draught conditions has been designed after exhaustive experiments and it is now possible by means of this appliance to burn the lowest grades of coal irrespective of ash and volatile content—even coals which were hitherto considered as so much colliery refuse,—thus opening up great opportunities to help the economic production of collieries and still further reduce the coal costs of factories and power stations. Present day conditions call for the very highest efficiency in steam generation and it is now possible with the company's latest water tube boilers to extract 85 to 87 per cent. of the available heat energy in the coal with chain grate stokers and economies even higher than this are practical with the powdered duel equipment combined with water cooled walls also made and supplied by the company.

Typical examples of up-to-date installations are shown in the plants of the South Manchurian Electric Co's Amanogawa Power Station and the Mitsui Miike Mine (Minato) Power Station. The former comprises the well known B. & W. High Pressure Cross Drum Boilers with Integral Superheaters. At the time of placing the contract the pressure and temperature adopted were the highest yet ordered in the Far East. Each unit has an integral economizer and air heater. The units are fired with pulverized coal in Bailey Hopper Bottom furnaces, these furnaces being designed for operation at maximum temperatures and to withstand the heavy wear due to molten slag flowing down the walls and hoppers. The Mitsui Miike Minato plant comprises similar equipment, but is exclusive of air heaters. These boilers are fired on the "Unit System" the complete equipment being supplied by Toyo Babcock Kabushiki Kaisha.

Boiler plants are now being erected in Japan the pressures being as high as 750 lbs. per square inch combined with Bailey Slag Tap furnaces, from which the slag and ashes are tapped in a molten state and finally conveyed away from under the boilers by means of hydraulic jets thus eliminating dust and all troubles connected with the older methods of ash handling.

It is noteworthy that the following list of requirements of a perfect steam boiler as prepared by George H. Babcock and Stephen Wilcox in 1875 still represents the best practice to-day and forms a fitting monument to the foresight and genius of the inventors.

(1)—Proper workmanship and simple construction, using materials which experience has shown to be the best, thus avoiding the necessity of early repairs.

(2)—A mud drum to receive all impurities deposited from the water, and so placed as to be removed from the action of the fire.

(3)—A steam and water capacity sufficient to prevent any fluctuation in steam pressure or water level.

(4)—A water surface for the disengagement of the steam from the water, of sufficient extent to prevent foaming.

(5)—A constant and thorough circulation of water throughout the boiler, so as to maintain all parts at the same temperature.

(6)—The water space divided into sections so arranged that, should any section fail, no general explosion can occur and the destructive effects will be confined to the escape of the contents. Large and free passages between the different sections to equalize the water line and pressure in all.

(7)—A great excess of strength over any legitimate strain, the boiler being so constructed as to be free from strains due to unequal expansion, and, if possible, to avoid joints exposed to the direct action of the fire.

(8)—A combustion chamber so arranged that the combustion of the gases started in the furnace may be completed before the gases escape to the chimney.

(9)—The heating surface as nearly as possible at right angles to the currents of heated gases, so as to break up the currents and extract the entire available heat from the gases.

(10)—All parts readily accessible for cleaning and repairs. This is a point of the greatest importance as regards safety and economy.

(11)—Proportioned for the work to be done, and capable of working to its full rated capacity with the highest economy.

(12)—Equipped with the very best gauges, safety valves and other fixtures.

In the light of the performance of the Babcock & Wilcox boiler under the exacting conditions of present-day power-plant practice, the foregoing list of requirements reveals the insight of the inventors of the boiler into the fundamental principles of steam generator design and construction.

Since the Babcock & Wilcox boiler became thoroughly established as a durable and efficient steam generator, many types of water-tube boilers have appeared on the market. Most of them, failing to meet enough of the requirements of a perfect boiler, have fallen by the wayside, while a few, failing to meet all of the requirements, have only a limited field of usefulness. None has been superior, and in the most cases the most ardent admirers of other boilers have been satisfied in looking up to the Babcock & Wilcox boiler as a standard and in claiming that the newer boilers were "just as good."

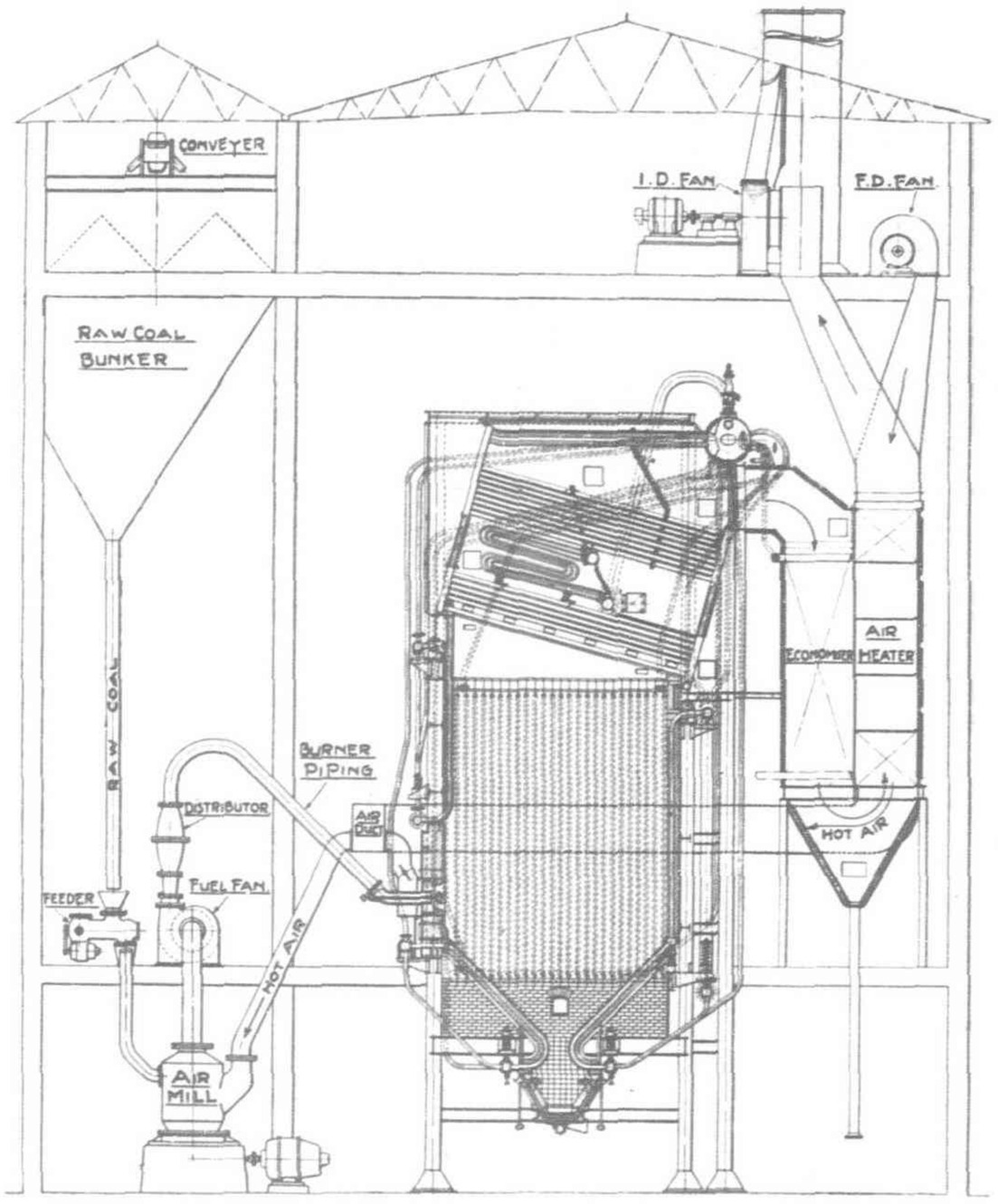
Records of recent performances, under the most severe conditions of service on land and sea, show that the Babcock & Wilcox boiler can be run continuously and regularly at higher overloads, with higher efficiency, and lower upkeep cost, than any other boiler on the market. It is especially adapted for power-plant work where it is necessary to use a boiler in which steam can be raised quickly and the boiler placed on the line, either from a cold state or from a banked fire, in the shortest possible time, and with which the capacity, with clean feed water, will be largely limited by the quantity of coal that can be burned in the furnace.

The distribution of the circulation through the separate headers and sections and the action of the headers in forcing a maximum and continuous circulation in the lower tubes, permit the operation of the Babcock & Wilcox boiler without objectionable priming, with a higher degree of concentration of salts in the water than is possible in any other type of boiler.

In the development of electrical power stations it becomes more and more apparent that it is economical to run a boiler at high ratings during the times of peak loads, as by so doing the lay-over losses are diminished and the economy of the plant as a whole is increased.

The number and importance of the large electric lighting and power stations constructed during the last ten years that are equipped with Babcock & Wilcox boilers, is a most gratifying demonstration of the merit of the apparatus, especially in view of their satisfactory operation under conditions which are perhaps more exacting than those of any other service.

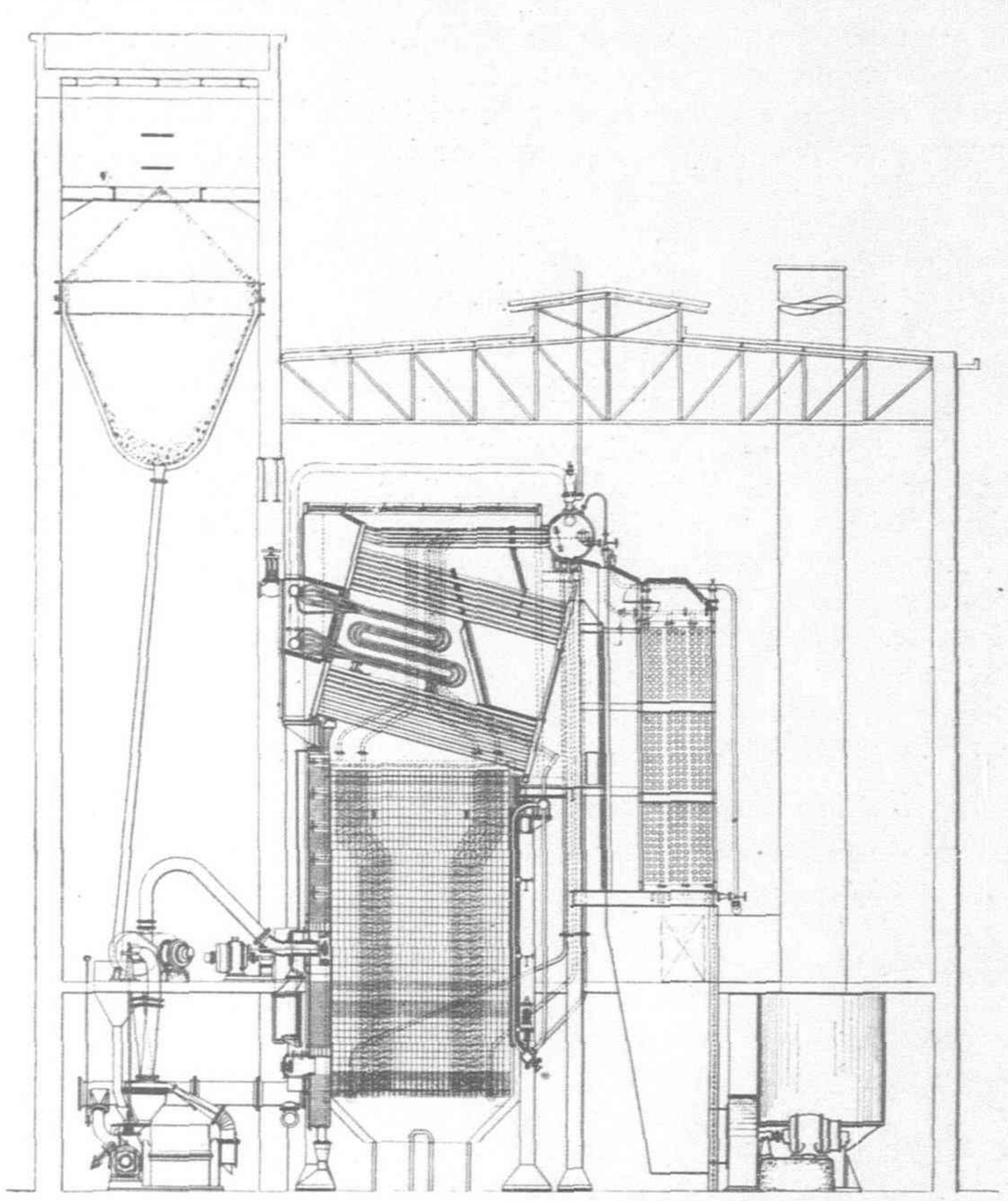
Time, the test of all, results with boilers as with other things, in the survival of the fittest. When judged on this basis, the Babcock & Wilcox boiler stands pre-eminent in its ability to cover the whole field of steam generation with the highest commercial efficiency obtainable. Year after year, the Babcock & Wilcox boiler has become more firmly established as the standard of excellence in the boiler-making art.



SOUTH MANCHURIAN ELECTRIC Co. (AMANOGAWA POWER STATION)

3-UNITS	HEATING SURFACE OF BOILER	8102 SQ. FT.	EACH.
"	" " SUPERHEATER	2098 SQ. FT.	"
"	" " ECONOMISER	5122 SQ. FT.	"
"	" " AIRHEATER	10566 SQ. FT.	"
	WORKING PRESSURE	483 LBS. PER SQ. IN.	
	FINAL TEMPERATURE OF STEAM 797 DEGREE FAHRENHEIT.		

REF. TO 20901 46. T.B.K. 1971 S.M.R. (AMANOGAWA)



MITSUI MINING COMPANY (MINATO POWER STATION)

2-UNITS	HEATING SURFACE OF BOILER	7060 SQ. FT.	EACH.
"	" " SUPERHEATER	2050 SQ. FT.	"
"	" " ECONOMISER	4900 SQ. FT.	"
	WORKING PRESSURE	385 LBS. PER SQ. IN.	
	FINAL TEMPERATURE OF STEAM 740 DEGREE FAHRENHEIT		

REF. TO 21314 22c 49a 79. 82a 94. MITSUI MINING COMPANY (MIIKE MINE)

Du Pont Executive Talks on Color

ONE of the most romantic stories in world industrial history is the rise and growth of the great Du Pont organization. This company started 125 years ago as a small manufacturer of gunpowder. Back in those days only a few customers were served. But now Du Pont's progress has reached a stage where thousands of products are made and sold to every country in the world. Mr. Ralph Plowman, Manager Export Sales of the Industrial Finishes Division of E. I. Du Pont de Nemours & Company, in a recent interview explaining work being done for greater beauty in the home said :

" I believe that we of the Du Pont company may take pride in the missionary work we are doing to make the world a brighter, more artistically colorful place to live in. We have spared neither time nor money to engage internationally known experts and color engineers to offer the public the best available advice on ' Beauty in the Home. '

" These authorities have not confined their suggestions to Duco or Du Pont products by any means, but have discussed draperies, rugs, silver, glass, furniture and the other accessories that go to make the home more beautiful, and more livable.

" Individual rooms have been carefully studied and discussed in many of the articles we have prepared. Exterior treatment of homes has also been considered. How to achieve the most pleasing effects with the least outlay of money has been explained.

" The mass of material on modern home treatment has been compiled by not only architects, designers, and interior decorators, but has been received from home owners themselves—from the wives who take pride in keeping their homes immaculately fresh and attractive.

" Naturally we have specialized in color in these considerations. We maintain that color, properly understood and courageously used, gives the home-builder an additional dimension of expression with which to obtain his or her desired effect while adding nothing to the cost."

Nanking Theater

Air-Conditioning Equipment

THOSE who have spent the summer months in America during the past few years, may have had the pleasure of enjoying perfect comfort in a theater when the outside temperature was as high as 100 degrees Fah. The Nanking Theater now offers this same opportunity to the people of Shanghai.

The Nanking Theater has the distinction of being the first theater in China equipped with mechanical refrigeration to produce a desirable temperature and humidity inside during the hot weather. Their entire cooling equipment has been designed and installed by York Shipley Inc., who have also installed the air cooling plant for the Cathay Hotel Ball-Room and the new offices of The Wayfoong House.

In order to produce proper condition inside a building where many people are crowded in a comparatively small space, there are four main things to consider.

Quantity of air.
Purity of air.
Temperature of air.
Humidity of air.

Consideration of these important items has led to the developing of a new branch of engineering called " Air-Conditioning." Without going into the history of this development, it is sufficient to say that the air-conditioning engineers have arrived at what they consider the most desirable degree of temperature and humidity inside a theater. They describe these ideal conditions as the " comfort line " which is based on the temperature and humidity of the inside air in comparison with the temperature of the outside air, and is best illustrated by actual figures as follows :—

Outside Temperature.	*Comfort Temperature Inside Theater*	*Humidity Inside Theater*
75°	73	60%
80°	75	60%
85°	76	60%
90°	77	60%
95°	80	60%
100°	83	60%

From these figures, it can readily be seen that no fixed temperature difference between the outside and inside air can be considered as satisfactory, although it is desirable to have a fixed percentage of humidity.

The engineer begins his calculation with the object of obtaining the above results inside, using the daily weather reports of the local observatory as his guide as to the expected outside air conditions. Taking Shanghai conditions, we find the average summer weather reports show 90 degrees Fah, and 70% relative humidity. The engineer must next calculate the amount of heat that must be removed from the building, and this consists of two large items and many small ones. The first large item is the heat penetration through the walls of the building, and may represent about 25% of the total refrigerating requirements. The second and largest item is the heat radiated by the people in the theater. This represents about 60% of the total refrigerating requirements. The average person sitting at rest radiates enough heat each hour to raise the temperature 400 pounds of water one degree Fah. This means that an audience of 1,600 people such as can be accommodated in the Nanking Theater will radiate enough heat each hour to raise the temperature of 640,000 pounds of water one degree Fah or sufficient heat to melt 5,000 pounds of ice.

The other factors to be considered in the refrigerating requirements are the heat radiated by lights, the heat brought in through opening doors, etc.

For a theater such as the Nanking, the total refrigeration calculated will amount to the equivalent of melting 300,000 pounds of ice each 24 hours. In other words, the amount of refrigeration used in 24 hours' operation by the Nanking Theater refrigerating plant could not be produced by the combined daily production of all the ice-making plants of Shanghai.

The next problem for the engineer is to distribute this enormous amount of cooling effect. His calculation will show that it will require the circulation of 50,000 cu. ft. of air per minute to distribute this refrigeration of 3,000,000 cu. ft. per hour. This air circulation is produced by a Multivane Fan of such a size that it requires a 40 h.p., motor to operate it. It also requires an elaborate system of air ducts to distribute this air to all parts of the theater and to collect the air again to be returned to the purifier. This system of air ducts is designed to introduce the air into the theater through the large openings in the ceiling, and collect the air through the openings under each seat for purifying and recirculating. These supply and return air ducts, serve the theater like veins and arteries sending pure fresh air into the theater over-head, and collecting the foul air by means of the openings in the floors.

The next step is the purifying, cooling and dehumidifying of the air. The apparatus for this purpose is called an "air washer," and consists of a large galvanized iron room fitted inside with spray nozzles which, when supplied with a suitable quantity of water under pressure, produces a finely divided spray through which the air blows ; this spray removes all form of dirt, dust, smoke, etc., and sends the air out to the theater with the freshness that is felt just after a rainstorm. This air washer also cools the air to the desired temperature, as the water which is used to produce the spray has been cooled to a low temperature. This air washer also performs a third, and perhaps its most important function, and that is the dehumidifying of the air.

If the question of humidity were not so important, it would not be necessary to cool the water below 68 degrees Fah, but as the air leaves the air washer at 100% humidity, it is essential that the temperature be low that it will produce 60% humidity when it warms up to the temperature in the theater.

Percentage of humidity means the proportion of moisture in the air compared to the total moisture that the air can absorb at any certain degree of temperature, and as warm air can contain more moisture than cold air, it follows that air must be cooled below the temperature required to condense out the moisture there by making the air dry when it warms up.

Some desired results can be achieved in more than one way, but the engineers have not yet found any practical methods of reducing the moisture content of air except by mechanical refrigeration. We have traced the course of the air circulation and described the cooling, dehumidifying and washing, and we will now describe the heart of the air-conditioning apparatus. This is the refrigerating machine which produces the cooling effect equivalent to the melting of 150 tons of ice per day. This machine consists of two large pumps which compress Carbon Dioxide gas to a pressure of 1,200 pounds to the square inch. Carbon Dioxide gas is used in preference to Ammonia gas for theater refrigeration, because it is harmless if any should escape. The same kind of Carbon Dioxide gas is used in this machine, as is used in the mineral water which we drink.

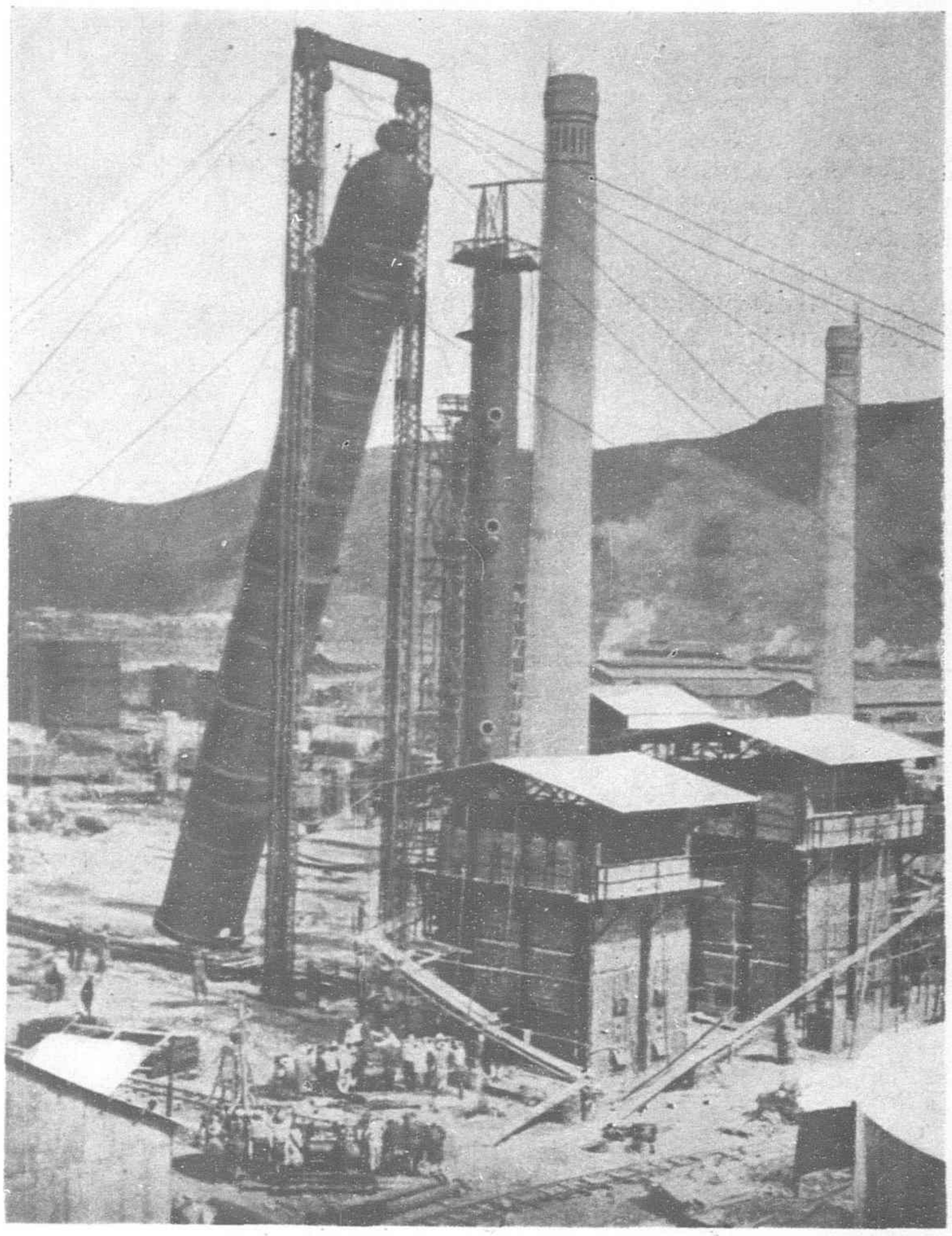
These gas pumps require a 200 h.p., motor to compress sufficient gas to cool the theater to the desired temperature. The gas after being compressed, is conducted to the roof of the theater where a set of Condensers 70 feet long, cooled by 300 gallons of deep well water per minute, is required to condense the Carbon Dioxide gas under high pressure to a liquid also at the same pressure of 1,200 pounds per square inch. This liquid Carbon Dioxide is conducted to a large tank containing 10,000 feet of pipe coils where the liquid Carbon Dioxide is reduced in pressure to 450 pounds per square inch, at which pressure it evaporates into a gas and produces the desired cooling effect during the process of evaporation. The pipes in which the Carbon Dioxide evaporates are surrounded by water which absorbs the cooling effect of the evaporating process, and by means of a large pump, the cooled water is circulated at the rate of 500 gallons per minute to the air washer to perform the air cooling and dehumidifying as described above. The gas evaporated in the water cooling process is pumped back to the gas compression pumps to be compressed again so that the same gas is used over and over again each cycle including compression, condensation and evaporation.

The York Ice Machinery Corporation, of which York Shipley Inc., is a branch, have been associated with the air-conditioning development since its beginning, and they installed the first refrigerating plant used for ball-room cooling in the Hotel Sherman in Chicago about 20 years ago. During the past few years The York Company have installed air-conditioning equipment in theaters for Kieths, Lowe's, Plantages, Stanley, Famous Players' Lasky, Fox, Hammerstein, and for many independent theaters.

Double Flash Distillation in Japan

WORK was started last year on a two stage, distillation unit for the Nippon Oil Company, Ltd., at Kudamatsu, Yamacuchi Ken, Japan. This equipment is now in operation. The accompanying pictures show the units both during erection and after completion. The entire distillation unit was designed by Foster Wheeler Corporation and includes an atmospheric tube still and tower, a vacuum tube still and tower, stack, heat exchangers coolers, pumps, receiving house and other accessories.

Crude is heated in the atmospheric still and fractionated by the atmospheric tower into gasoline, naphtha, kerosene, gas oil and reduced crude bottoms. The reduced crude is further heated in the vacuum still and fractionated by the vacuum tower into gas oil, wax distillate, wax slop, overhead cylinder stock and asphalt bottoms.

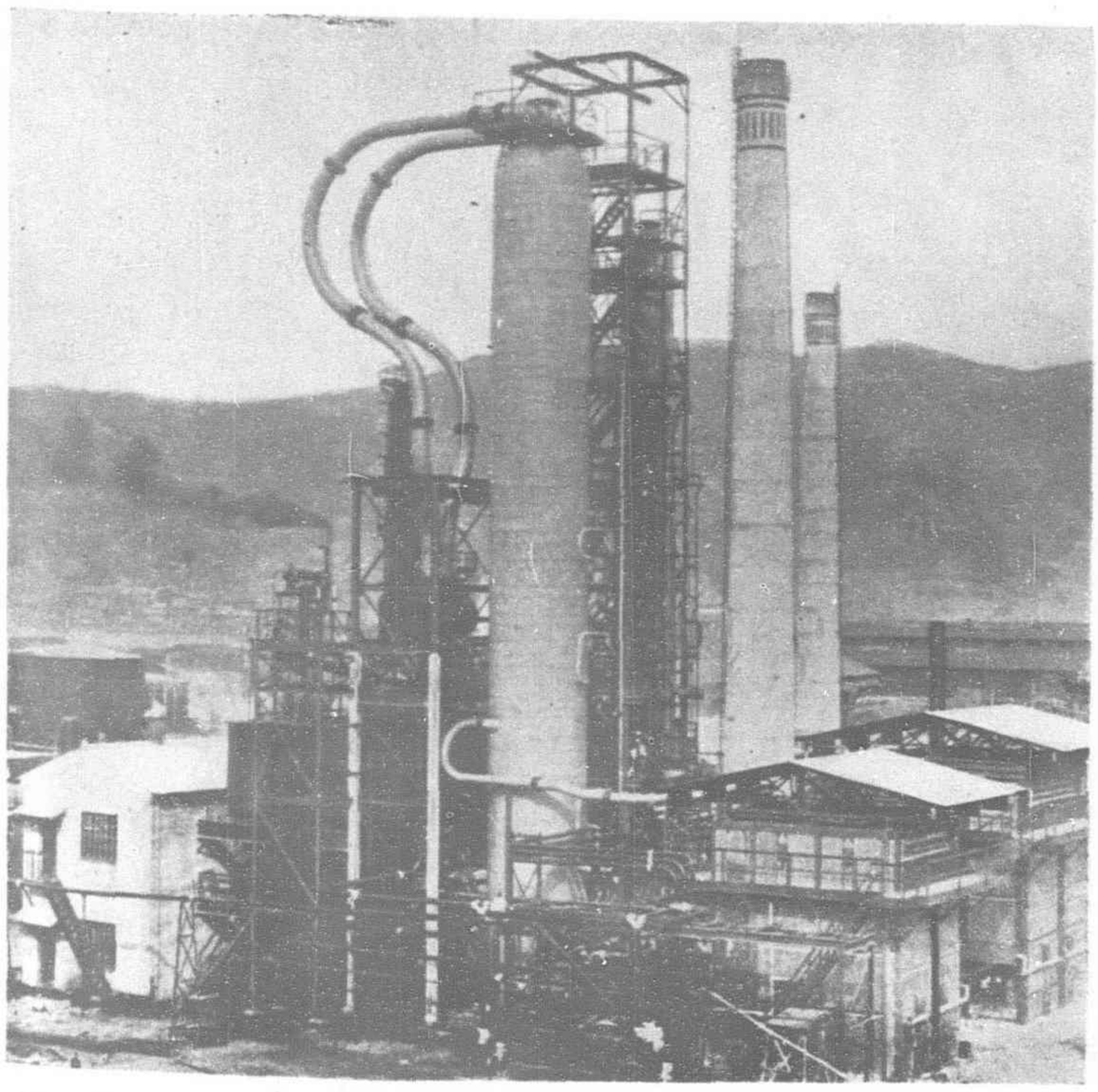


Erecting A Fractionating Tower in Japan Erection of the Two Stage Foster Wheeler Distillation Unit of the Nippon Oil Company was Performed by Mannal Labor. This Picture Shows Thirty-two Coolies Operating the Two Hand Winches Used in Erecting the Vacuum Tower

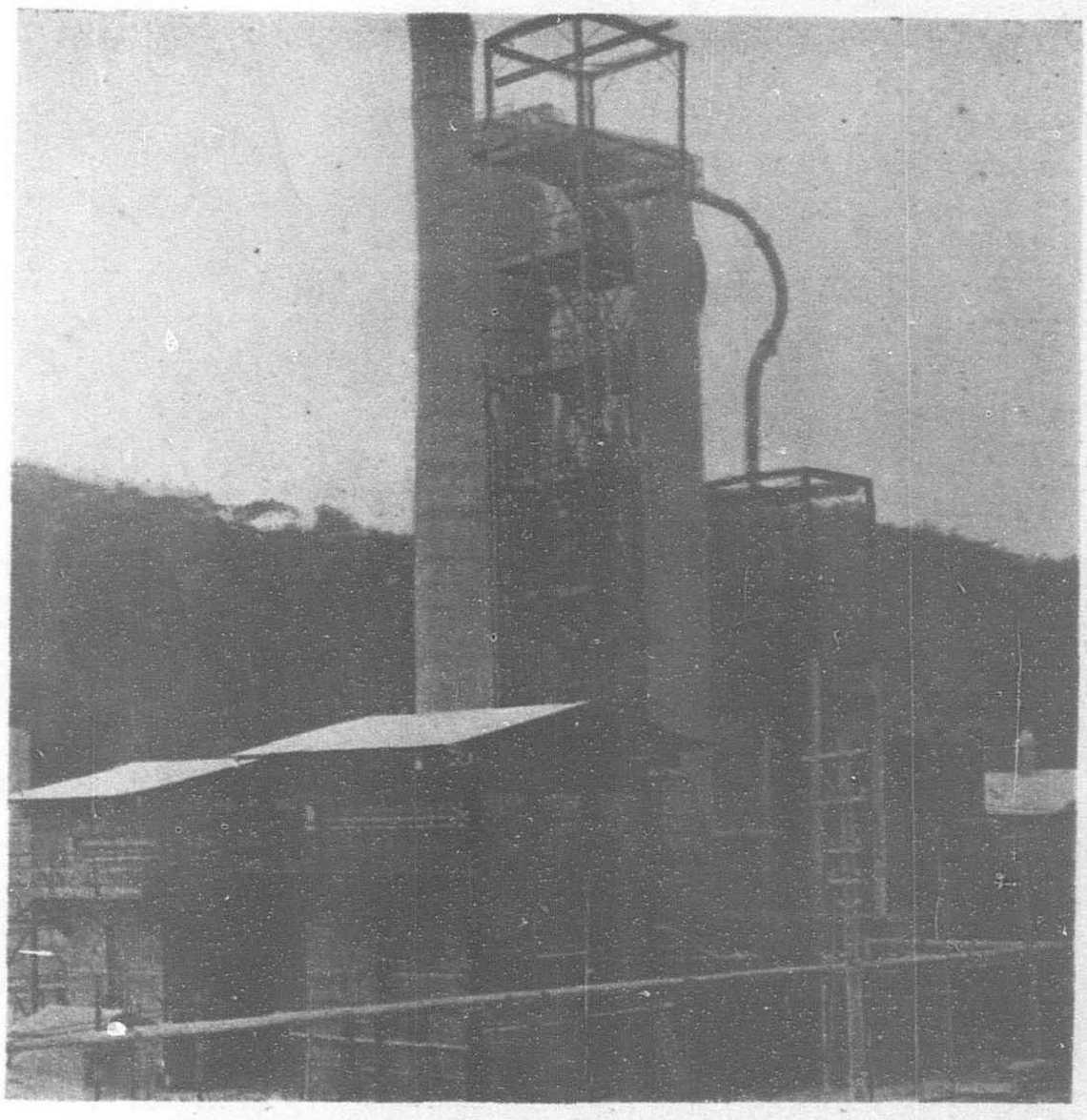
Each still contains a superheater for heating exhaust steam from the pumps preliminary to use in the towers.

Many interesting problems arose in the construction of this equipment so far away from the point of manufacture. Practically all operations were carried out by manual labor even the hoisting of the towers, as can be seen by the picture on this page. One of the interesting features of the construction work is the scaffolding composed of bamboo poles tied together which gives the appearance of tubular scaffolding used in the most modern construction jobs in America.

In spite of the inexperience of local labor handling this equipment the completed installation presents a remarkably fine appearance. The painstaking labor of the Japanese is plainly visible in the neatness of the insulation on piping and to towers as well as the general neatness in all details.



Two Stage Foster Wheeler Distillation Unit of the Nippon Oil Company Showing Pump House and Receiving House at the Left, Vacuum Bubble Tower in the Center and Tube Stills at the Right



Distillation Unit Installed for the Nippon Oil Company, Showing the Details of the Atmospheric Bubble Tower and Steel Work Between the Atmospheric and Vacuum Towers

Differential Surge Tank for Japanese Hydro-Electric Plant

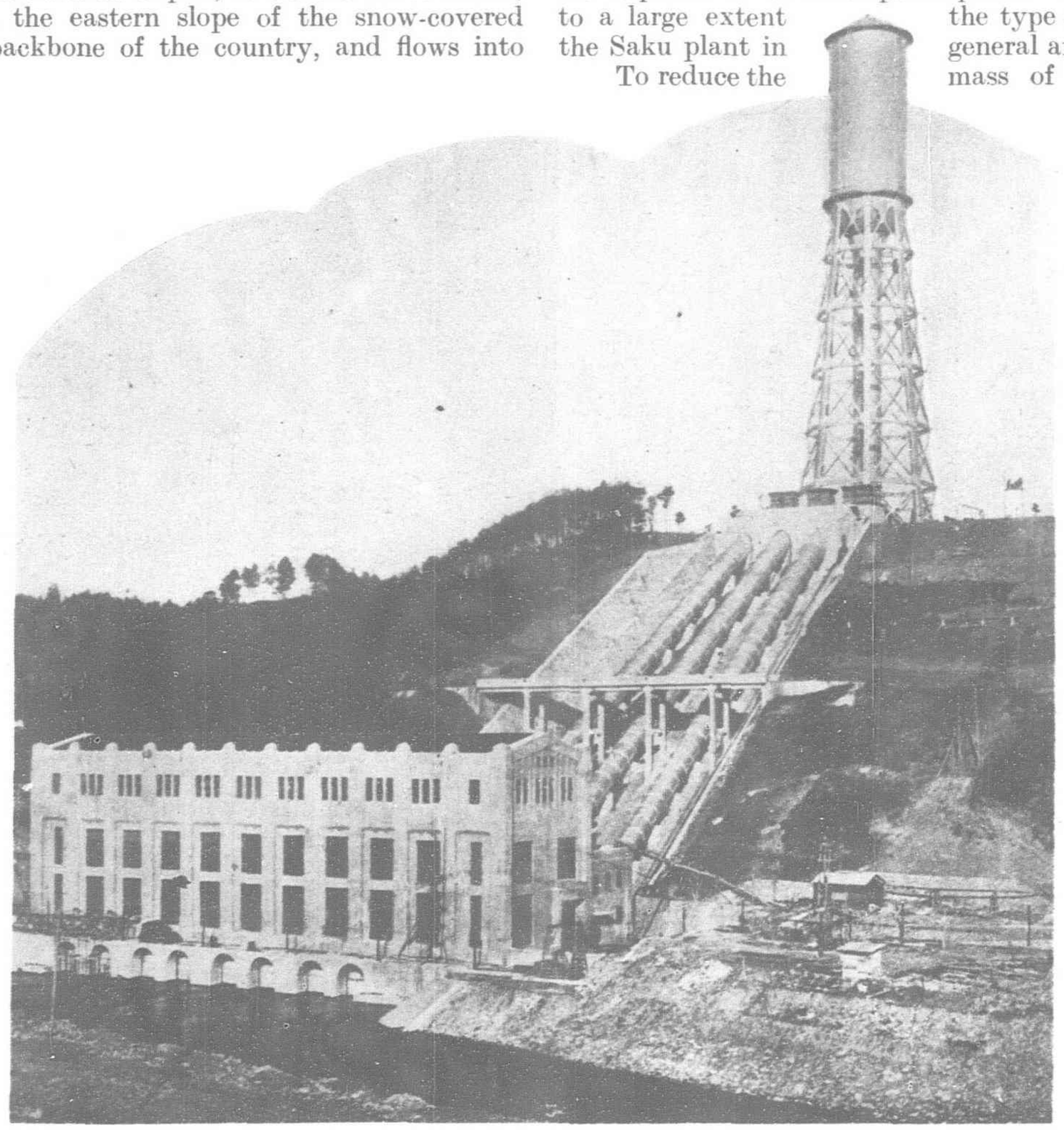
THE Kanto Hydro-Electric Power Company utilizes a Johnson Differential Surge Tank to regulate its new 55,000-kilowatt Saku plant. This project, which is the largest of its kind in Japan, is on the Tone River, which has its source on the eastern slope of the snow-covered mountains forming the backbone of the country, and flows into the Pacific Ocean.

The dam consists of a straight wall gravity type structure 354 feet long and 40 feet high, surmounted by three roller gates 15 feet high and 58 feet long, two Stoney gates 15 feet high by 21 feet wide and three Stoney sluice gates 32 feet high and 12½ feet wide. This combination was selected to discharge quickly a large quantity of flood water, so as not to endanger a government railway and a prefectual highway on one bank and a village powerhouse less than a mile upstream.

Owing to the steep slopes and the proximity of the watershed, large amounts of debris are brought down by the floods. The water passes into the intake, through a small tunnel 600 feet long at a high rate of speed to a sand basin where the velocity is reduced to ½ foot per second so as to deposit all objectionable materials.

From the sand basin the water flows about 7½ miles through an 18½-ft. by 18½-ft. horseshoe-shaped tunnel to a 30,000,000 cubic ft. capacity regulating reservoir. A 15-ft. diameter pressure conduit 4,358 feet long carries the water from there to the surge tank and the penstocks leading into the powerhouse. The first 1,000 feet of this conduit, where the head is about 60 feet, is built of reinforced concrete, and the remainder is steel pipe. Owing to its size, the pipe line is provided with steel saddles resting on concrete supports 22½ feet apart. Anchor blocks are inserted about 450 feet apart. Expansion joints midway between the anchor blocks are of the telescopic type built of steel plates.

Since the earthquake of 1923, all important structures in Japan are required to be earthquake-proof. This regulation determined to a large extent the type of structures to be used in the Saku plant in general and the tank in particular. To reduce the mass of the tank and its water content as much as possible, the Johnson Differential type of surge tank was selected as it required only about one-half the cross-sectional area of a simple tank for the same purpose. The installation made has a capacity of 965,000 gallons and is 157½ feet to bottom and 262 feet to top. The shell of the tank is 41 feet in diameter and 84 feet high. The external riser is 15 feet and the internal riser 12 feet in diameter.

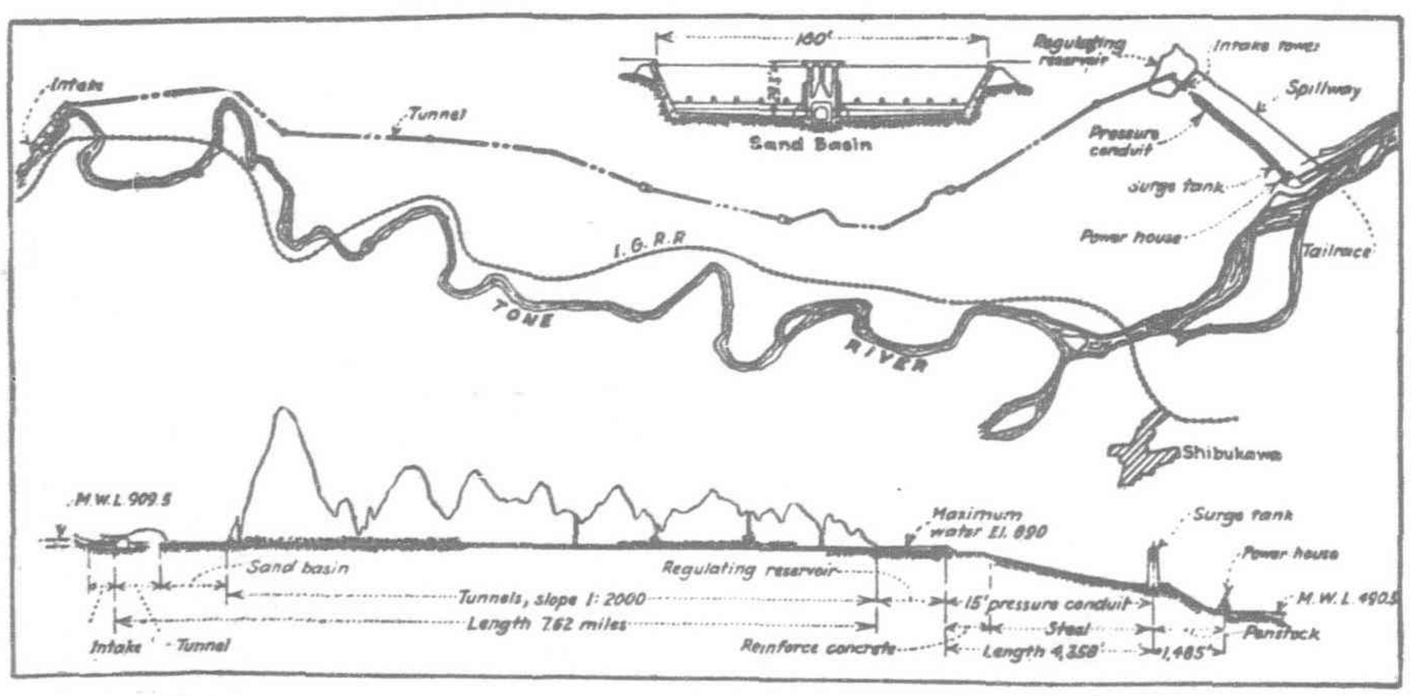


Johnson Differential Surge Tank at the Saku Plant of the Kanto Hydro-Electric Company. The Tank has a Capacity of 965,000 Gallons and is 157-ft. 6-in. to Bottom

The advantage of the differential surge tank can be seen when the overturning moment induced by an earthquake is compared with that caused by wind pressure. In this case the tank was designed for a horizontal seismic acceleration of 1,500 mm. per sec. The total overturning moment in kip feet (1,000 pound feet) is 211,760, whereas the moment caused by wind pressures of 40 pounds per square foot on the shell and 60 pounds per square foot on the projected area of the supporting tower is 61,000 or a ratio of 3½ to 1.

The shell of the tank is designed to resist the horizontal shearing stress induced by earthquake, the shearing stress being caused by the horizontal component of the seismic force acting on the water and metal. One $8 \times 3\frac{1}{2} \times \frac{1}{2}$ inch angle is required for each shell plate of seven foot height to stiffen the shell. The balcony girder was designed to take care of the thrusts induced by the posts. On the outside, two

(Continued on page 432).



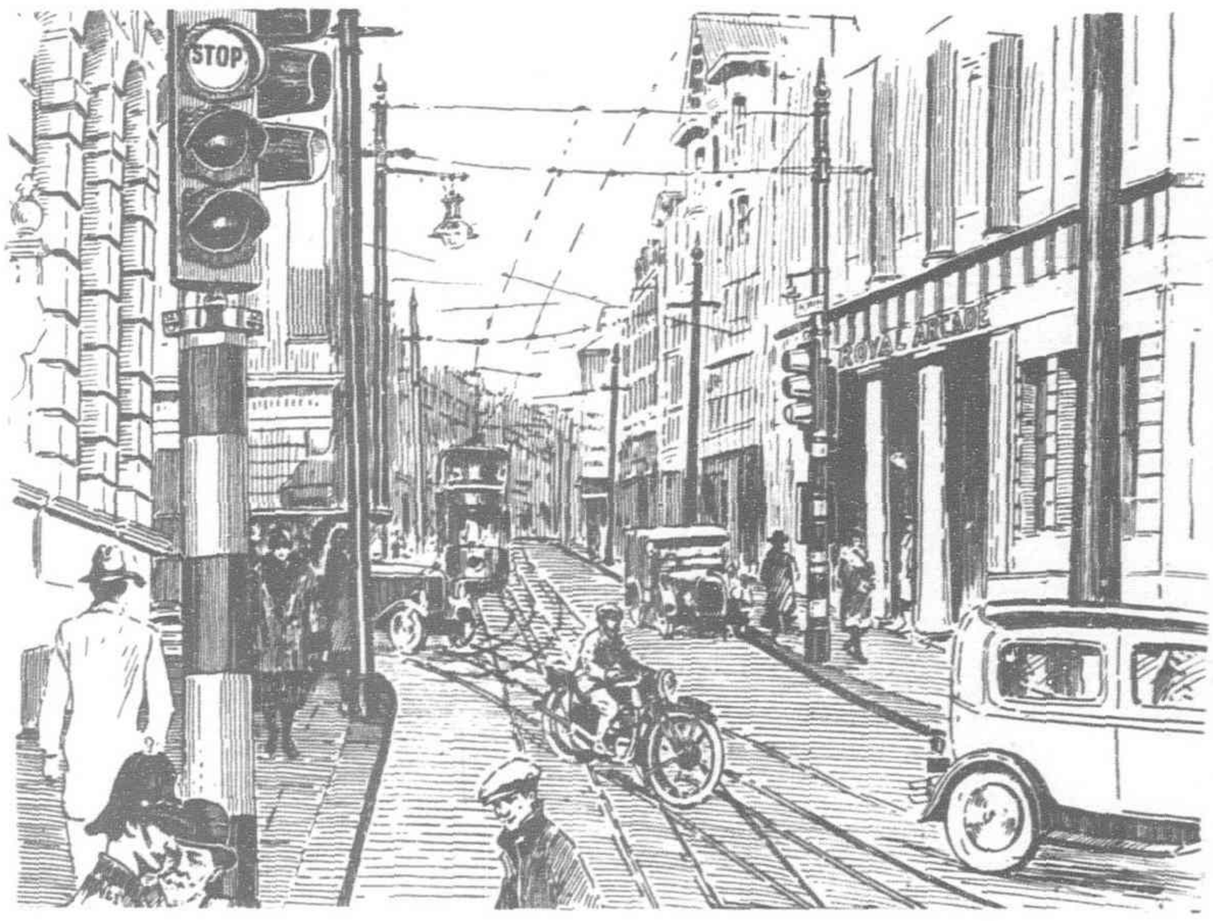
Plan and Profile View of Saku Hydro-Electric Project on the Tone River, 80 Miles from Tokyo

Street Traffic Control by Electrically Operated Equipment

THE problem of obtaining maximum efficiency in the use of public streets has become of very great importance in these days of greatly increased vehicular traffic. The most important factor is, of course, the time required for traffic movement, but gains in this direction must not be made at the expense of public convenience and safety.

When the need for controlling traffic first became evident, policemen were posted at the more congested crossings. This method of control is expensive, as at least two shifts of men are required at each controlled point, and it also suffers from the drawback of limited effectiveness, due to the short range at which the Constable's signals are visible. For instance, a Constable may allow traffic to proceed at one point when, unknown to him, it has been held up at the next, thus causing considerable confusion.

When these limitations were realized, a demand arose for improved methods, and automatic electric control equipments were developed which enabled vehicular and pedestrian traffic to move expeditiously, safely and economically, so that the greatest volume could pass through a controlled area in a given time, and the efficiency of such equipment has been proved by the great increase in its use in Great Britain during the past year.



A Holmes-Reyrolle Equipment Working in Newcastle-on-Tyne

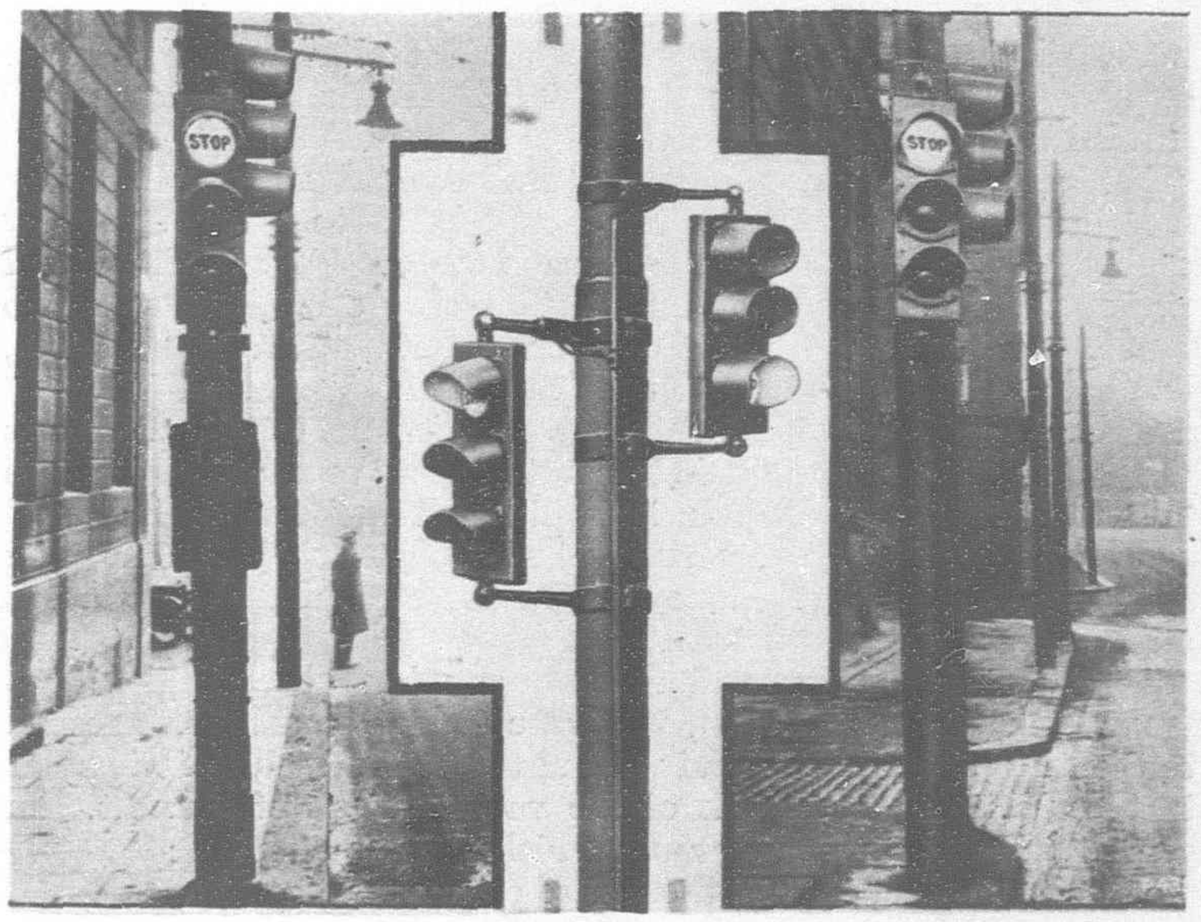


Fig. 2

The earlier installations used were erected and operated in a manner decided by each individual municipality, with the result that long-distance traffic found different regulations in force in different towns and cities. This indiscriminate use of automatic control is to be strongly deprecated, and with a view to obtaining uniformity throughout Great Britain recommendations were issued by The Ministry of Transport in Memorandum No. 297 (Roads) during September, 1929.

Whilst bearing in mind the desirability of uniformity, careful investigation of local conditions should be made in each city before signals are installed, and consideration given to the possibility of using either the "LIMITED PROGRESSIVE" or "FLEXIBLE PROGRESSIVE" systems of control.

Usually one or the other of these two systems can be applied with advantage to streets where a number of signals are installed at adjacent intersections, as by linking them for operation in series a maximum flow of traffic can be passed through the series of signals without stoppage. The "LIMITED PROGRESSIVE SYSTEM" is chiefly applicable where the intersections to be controlled are at approximately equal distances apart. The signals are arranged to give opposite indications at each intersection, *i.e.* when one group shows "RED" the other shows "GREEN," and so on, and, being controlled from a central point, all signals change at the same time. Under these conditions the traffic is divided into groups, and continuous movement is permitted at a pre-determined uniform speed. By conforming to the recognized speed, the driver of a

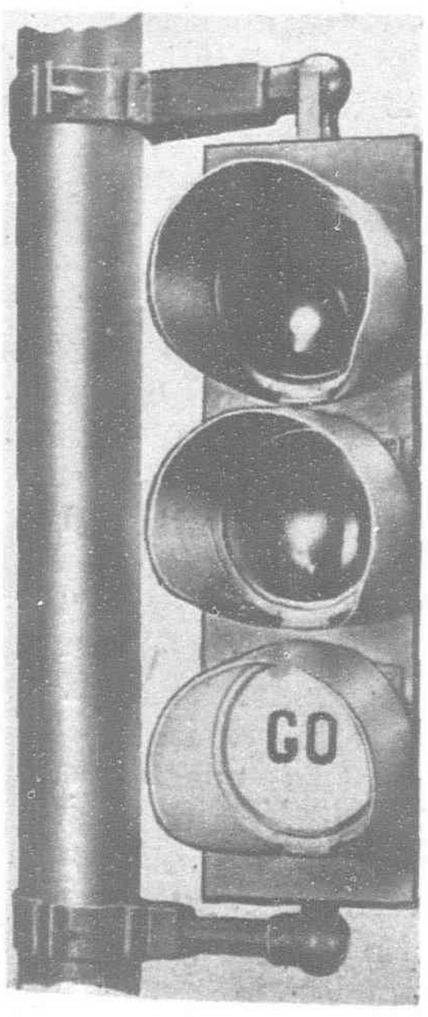


Fig. 1

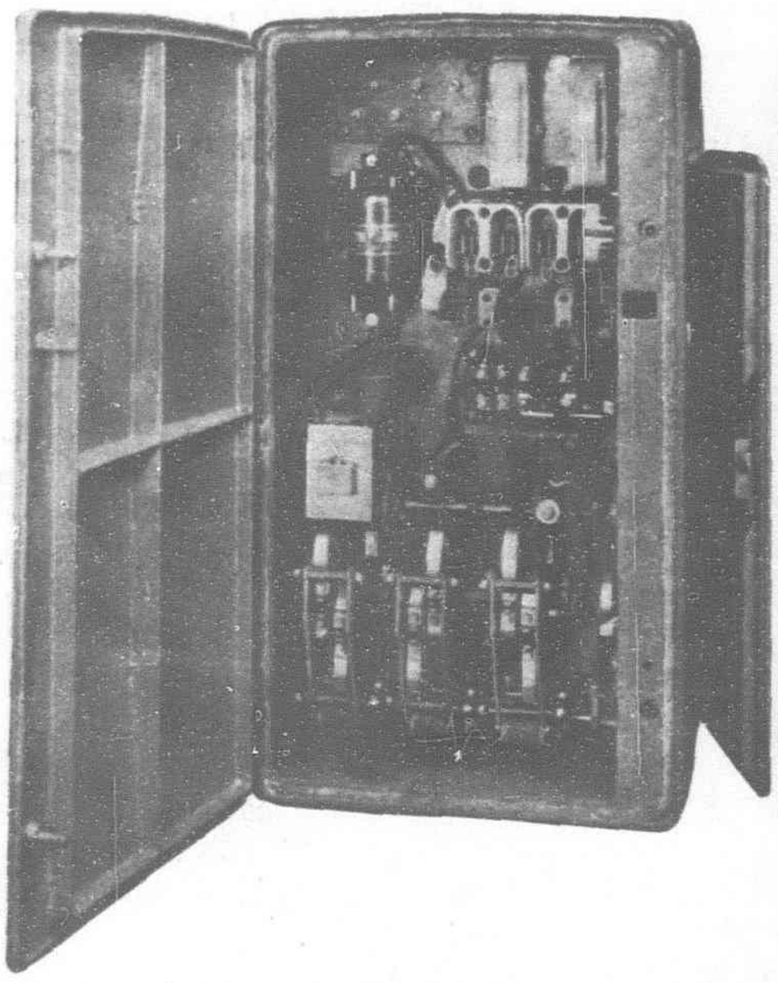


Fig. 3

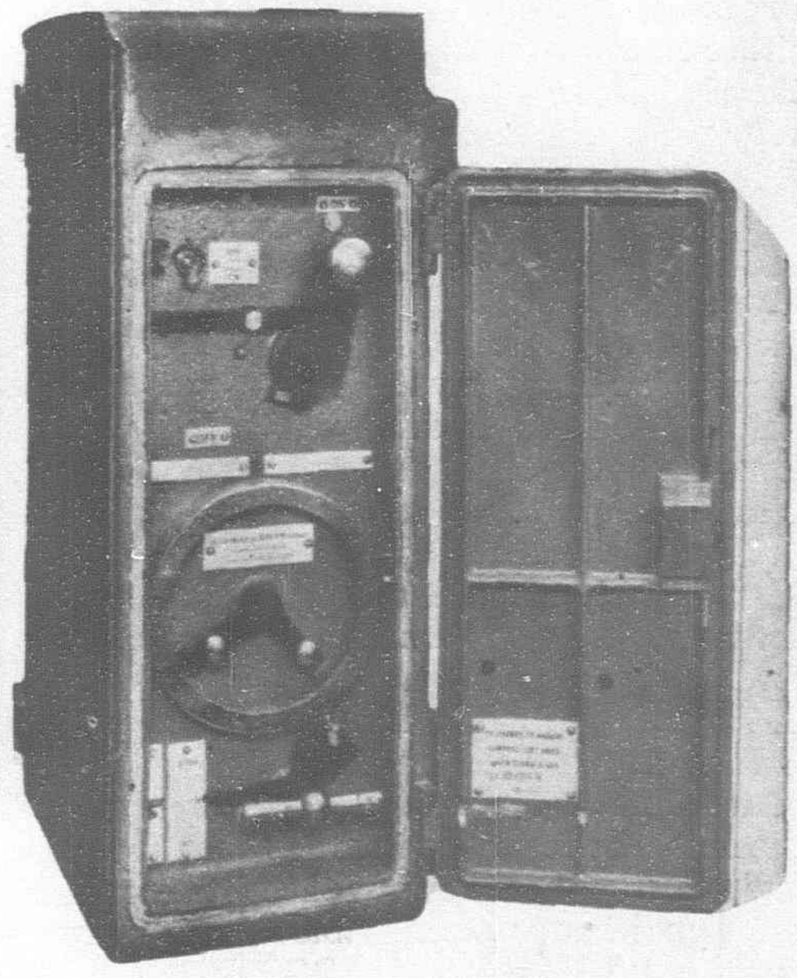


Fig. 4

vehicle will find that each group of signals will change to " GREEN " as he approaches.

Where the intersections are at unequal distances apart, a continuous flow of traffic can be obtained by the " FLEXIBLE PROGRESSIVE SYSTEM. " With this system the complete cycle of changes is of the same duration for all the controlled intersections, but the total time at each intersection can be divided between the main traffic and cross traffic to suit the volume of each. By taking advantage of the varying volumes of cross traffic, the maximum period can be allowed for free movement of the through traffic.

Practically all signal lamp boxes have the three signals " RED," " AMBER," and " GREEN," arranged vertically one above the other in the order named, with " RED " at the top as shown in Fig. 1. Originally, it was usual for the " Amber " signal to show alone between changes from " Red " to " Green " and *vice versa*, but after observing the behavior of traffic in automatically controlled areas, it was decided to modify the signal indications, and the sequence of changes now adopted is as follows : (1) " RED," (2) " RED " and AMBER " together, (3) " GREEN," (4) " AMBER," (1) " RED, and so on. The purpose of the " AMBER " is to give warning of an impending change from " RED " to " GREEN " or " GREEN " to " RED " as the case may be. To warn drivers of vehicles which have been stopped that they should get ready to move, the " AMBER " is shown concurrently with the " RED ", but they must not proceed until the " RED " and " AMBER " are replaced by " GREEN." As an indication that " RED " is about to be shown, the " AMBER " appears separately after the " GREEN ". The period during which " RED " and " AMBER " show together in one direction coincides with the period during which the " AMBER " alone shows after the " GREEN," in the other direction of the intersection.

Although standardization appears to have been achieved so far as signals are concerned, the same cannot be said with regard to the mounting of them, and we find that opinions differ widely as to the merits and demerits of the various types of support. In general, there are three methods which may be adopted :

(1) On a pedestal in the centre of the intersection.
(2) Suspended over the centre of the intersection.
(3) On poles at each corner of the intersection.

Signals mounted in the first manner are easily seen ; they keep the traffic in line, and prevent cutting when taking a right or left hand turn. But unless the streets forming the crossing are wide, they become an obstruction to traffic, and are somewhat expensive to install, since they involve taking up a portion of an important and busy thoroughfare, in addition to causing considerable dislocation of traffic.

The second system is comparatively cheap, and causes no obstruction ; but, owing to the height at which the signals must be mounted in order to clear vehicles, they cannot be easily seen, and this system is therefore not recommended.

The third method is the one most widely used in Great Britain. It does not cause obstruction to traffic, and since there are usually either tramway or lamp standards in existence at convenient points, the signals can often be quickly and cheaply mounted on them. Where there are no existing standards, the signals are mounted on separate poles. Fig. 2 shows a typical installation where advantage has been taken of the presence of tramway standards.

With this system, there still exists some diversity of opinion whether the signals should be on the far side or on the near side of each street forming the intersection. Decisions on this point should be governed by the width of the streets. When far-side mounting is favored, it becomes essential that each signal should be shielded from traffic approaching at right angles, and this is done by fitting a larger cowl, which envelopes the lens more completely than the usual near-side cowl does.

The control mechanism, is, of course, the main item in the equipments, and it must be robust, reliable and flexible. Up till recently most of the available apparatus was of American origin, but the " Reyrolle-Holmes " equipment, which well illustrate, is of British design and manufacture throughout, being made by Messrs. J. H. Holmes & Co., Ltd., of Newcastle-on-Tyne, England. That the necessity for robustness has been kept in mind is shown by Fig. 3, and is further borne out by the fact that the contactors which operate the signal lamps are capable of controlling up to twelve crossings on the " LIMITED PROGRESSIVE SYSTEM " without the use of additional relays or other devices. This is of considerable value in keeping installation costs down. The controls are in a separate side compartment isolated from all live parts, as shown in Fig. 4, and provision is made for operating the signals manually should special circumstances arise which make this desirable.

An interesting feature of the " Reyrolle-Holmes " signals is the fitting of chromium plated reflectors behind the gas-filled lamps. These serve to give a brilliant light, and have obvious advantages in respect of maintenance over the usual glass reflectors. Further, they do not suffer ill effects from fog and dampness.

Before installing signals, particular attention should be given to local conditions, with due consideration to maintaining uniformity throughout the country, since only in this way can the fullest advantages be obtained.

Osaka to Build Modern Sewage System

(Continued from page 424).

1926, on such points as the effect of activated-sludge at different quantities when mixed with the sewage treated, the effect of air pumped into the sewage at various degrees of volume, the atmospheric effects on the entire process at different seasons of the year, and also on the dehydration of the surplus sludge.

The results have been found perfectly satisfactory. It has also been discovered that the operation of this experimental plant was a financial success.

It is on account of the foregoing satisfactory results that the Municipal authorities of Osaka have decided to build five activated-sludge sewage disposal plants on a larger scale at different parts of the city to treat the sewage and excreta all over the city, and to build two of them at an estimated cost of Y.17,000,000 to begin with, in the course of six years to come.

Differential Surge Tank Japanese Hydro-Electric Plant

(Continued from page 430).

$8 \times 8 \times \frac{3}{4}$ inch angles are riveted to the tank shell at each post, extending from top to bottom, as an additional safeguard.

The shell of the tank proper, roof, bottom, riser pipes and top section of the tower were fabricated in the Greenville plant of the Chicago Bridge and Iron Works and the remainder of the tower was fabricated in the Asano dockyard in Japan. The entire structure was erected under the direction of foreman Adolph Eastman.

All of the material for the tank was raised with an elevator tower, which had two sliding booms on opposite sides. Both booms could be used at once and could be raised or lowered to any position. When the job was complete the tower was taken apart and taken down through the riser.

The scaffolding used consisted of pine poles lashed together with straw rope. Electric hoists were used extensively for all types of lifting. Other equipment was similar to that used on an ordinary elevated tank in the United States, except that the work was carried forward on a more extensive scale. At one time there were 33 men working on the inside of the tank bottom alone, comprising five reaming gangs, five riveters, three caulkers, five fitting-up gangs and two inspectors.

Just below the surge tank the conduit is divided into three penstocks, each learing to a vertical shaft Francis type turbine which will develop 36,000 h. p. at full gate under 390 feet. Maximum net head at 300 r. p. m. The three turbines are connected to three 28,000 kva. 11,000 volt 50-cycle 300 r.p.m. vertical shaft generators with 140-kw. 250-volt direct connected exciters.

A two-circuit transmission tower line about two miles in length connects the Saku station with the transmission line of the Joyetsu system of the Tokio Electric Light Company, who buys the power.

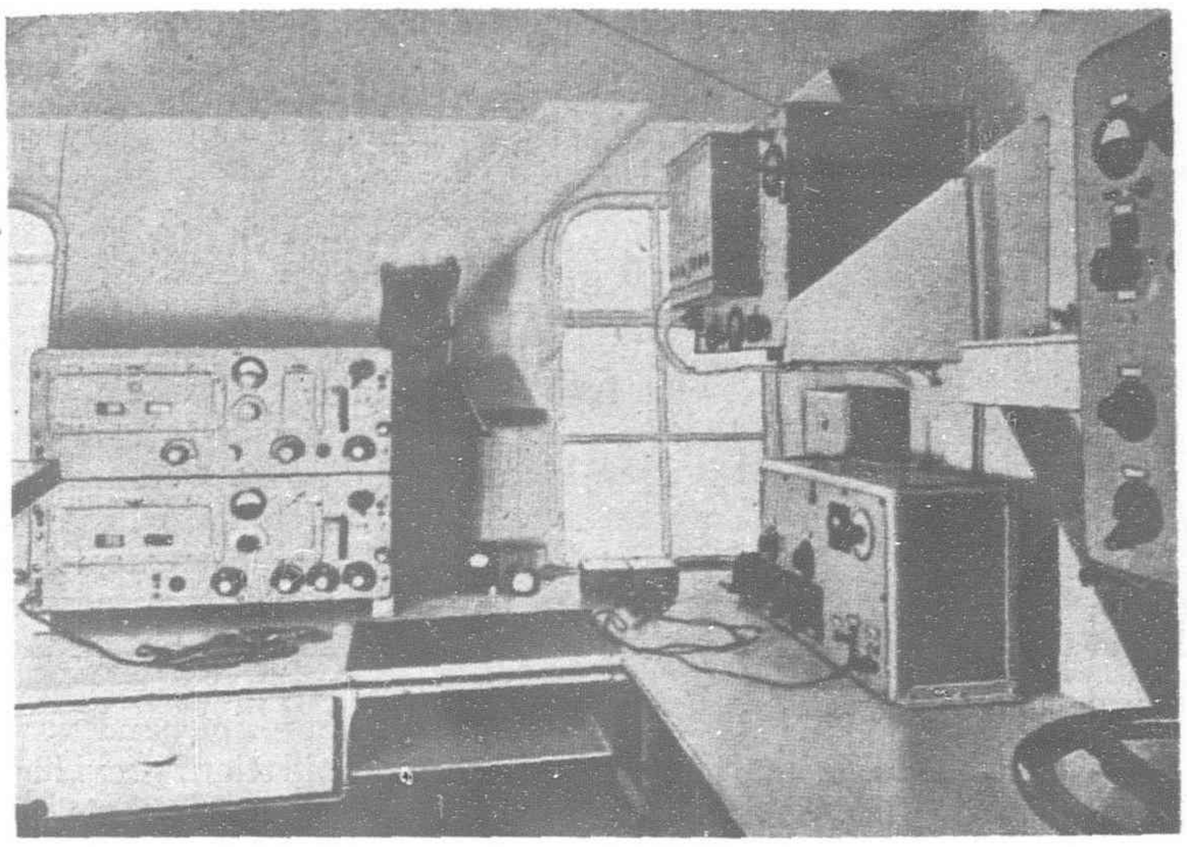
The construction of the Saku project was in charge of K. Tsuruta, Chief Engineer of the Kanto Hydro-Electric Power Company. R. Nukushina had charge of the electrical engineering and S. Shimodao supervised the civil engineering departments.

The Ways of Wireless

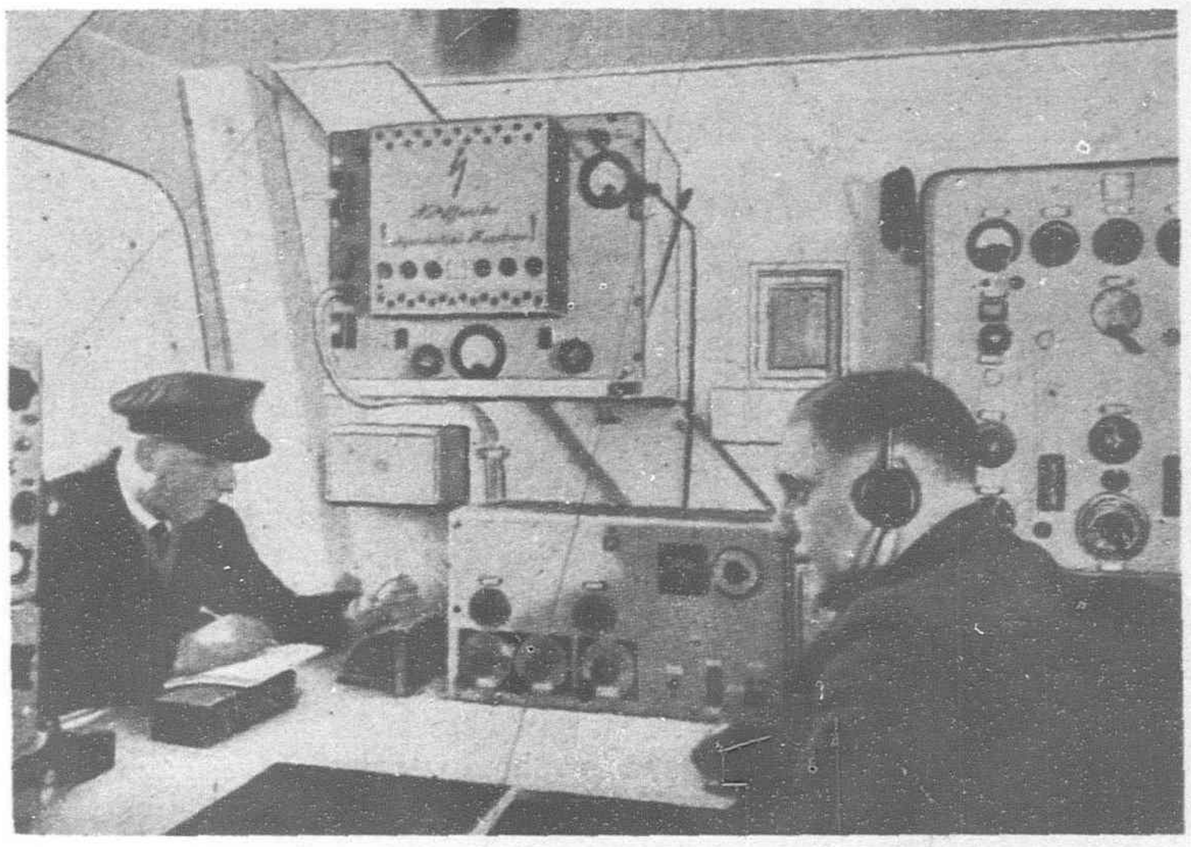
By R. HIRSCH, Chief Engineer of Telefunken

FOR EVERYBODY, that is the pass-word of wireless. It means: broadcasting of speech to all corners of the world at definite times, to an unlimited audience of listeners. The innumerable broadcasting companies of the world perform this task.

Transmissions in a certain direction, to a certain receiving station, at any moment; written reception and the material transmitted kept as secret as possible—that is how the program of the big wireless telegraphy companies is arranged.



Telefunken-receiving Station on Board the "Graf Zeppelin"



Telefunken Station on Board the "Graf Zeppelin"

Wireless accomplishes these two radically different tasks. It can diffuse intelligence in all directions or it can be concentrated in one definite point, or it can change direction in much the same way as a searchlight changes the direction of its beam.

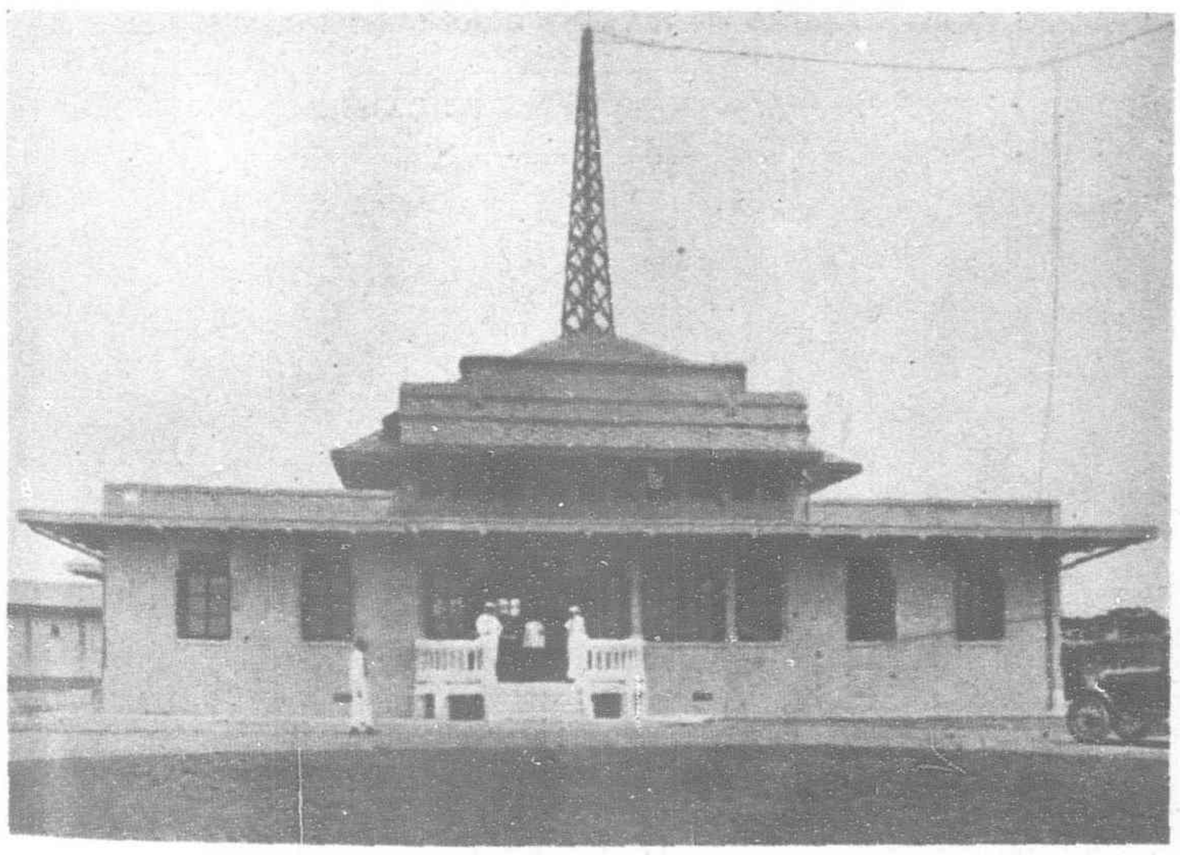
Seven years ago when wireless first came into being there was hardly any competition. It is true that there were telephone exchanges which sent out news and sometimes music on their wires, but a conversation or a program for everybody, as we accept it to-day was unheard of. Wireless was, from the day of its birth, something entirely new.

The growth of radio telegraphy development was different. From the beginning there existed an old-established competitor which has worked satisfactorily for years and has supplied all traffic needs for a considerable time—the cable. Radio was very slow in catching up with the cable. About five years ago matters apparently came to a standstill. Up to that time it was possible to increase the power radiated up to hundreds of kilowatts by means of machine transmitters. The long waves of this system needed extensive aerial arrangement with dozens of expensive masts sometimes over 200 metres high, and spaces for stations with areas of several square miles. For reasons of ceonomy any further development in this direction was impossible.

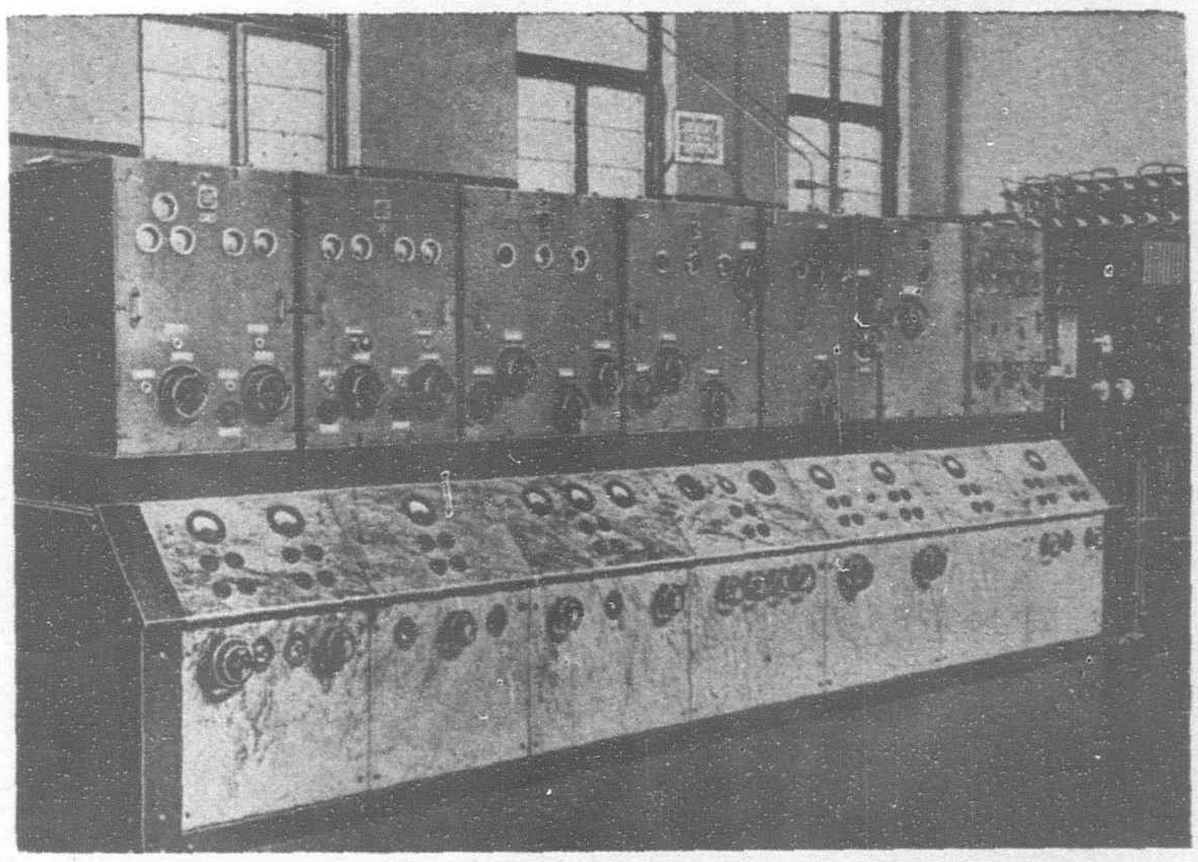
Then a miracle happened; just at the moment of stagnation, or better, at the moment of the close of all development, new channels were suddenly opened up.

The discovery was made that it is possible to cover undreamt of distances with the short wave. It is true, it was an accidental discovery, but one of tremendous importance, for the production and radiation of the short-wave could be carried out with much simpler means than the long waves! Smooth glass tubes replaced the heavy machines. A few wooden poles replaced the forest of iron masts.

To begin with, this sensational simplification needed practically no explanation. Systematic research in all countries, carried out with the greatest intensity produced sufficient material to establish



Telefunken-short-Wave Station for Wireless Telegraphy and Telephony in Bangkok, Siam



Telefunken Short-Wave Transmitter for Overseas Traffic

a fairly accurate theory. The result is that, to-day, wireless connections can be made between any given points on the earth's surface. These same connections enable telegrams to be sent at the rate of 300 words per minute at almost all times of the day or night, and, further enable duplex-telegraphy and transmission of black and white pictures. It is even possible to telegraph and telephone simultaneously with the same broadcaster and receiver.

At one blow the output degree of the cable if not in all points, at least in most was reached and in some cases surpassed. To-day radio is considered to be of equal value with the cable, particularly in transoceanic telegraphy over great distances. This can be seen in America, England, Italy and Germany, where cable and radio companies have come to agreements and even amalgamated in order to end the fight of competition.

The German Transradio Co., Ltd., for wireless overseas traffic possesses no fewer than 11 direct overseas lines, namely, two to North America, one to Mexico, to Brazil, to Argentine, to Chile, to Java, to Siam, to Japan, to China, to the Philippines and to Egypt. The transmitters for these lines, built by the Telefunken Company, are to be found in the super-radio station at Nauen near Berlin, the receivers in the super receiving station at Geltow and Beelitz near Potsdam. On three of these lines, *e.g.* on the lines to Brazil, Argentine, and Java, public telephone traffic has been introduced. More transoceanic telephone lines will follow.

The antenna for the transmitter is exact and thorough, both in design and construction. This installation consists of so-called radiators and reflectors, the purpose of which is to concentrate the beams as much as possible and to cause them to travel in one direction and not backwards and forwards around the earth simultaneously to distant duplex-stations.

The receivers of the big wireless telegraphy stations look a little different from the usual broadcast receiver ! They are about six feet high, three feet wide, and weigh not less than seven cwts. They contain 19 valves ! It is true that one can occasionally hear long distance stations with an ordinary wireless receiver, but the commercial side of the transoceanic telegraph station demands not occasional but permanent, 100 per cent. reliable reception and it is not possible to achieve this with the ordinary simply constructed set.

Aeronautic Success Due to Electrical Equipment

ELECTRICAL equipment one of the important factors in the rapid advance of aerial transportation. No one firm has contributed more to the perfection of this branch of airship, aeroplane and motor car development than the famous Robert Bosch A. G. of Stuttgart, Germany.

The record of its successes during the past few years includes the airship Norge, on its famous Amundsen flight to the North Pole which was equipped with Bosch spark plugs. The Junkers aeroplane which made its trans-Siberian flight to Peking was equipped with Bosch Magnetos and Spark Plugs. The Junkers Aeroplane Bremen which made the historical flight across the Atlantic Ocean was equipped with Bosch Magnetos and Spark Plugs. The Graf Zeppelin and the airship L.G. 26, were equipped with Bosch Magnetos, Spark Plugs and Oilers, specially constructed for them.

Below is the photograph of Magneto G.F. 12.A. (driving end).

When the usual type of magneto, producing only two sparks for every revolution, is used for multi-cylindered engines (six or more) very high magneto speeds are necessary which, for instance, in the case of 12 cylinder engines, as now frequently used for aero work, amount to three times the crankshaft speed.

What this means for the rotating parts of the magneto, armature with winding, contact breaker and condenser, will be at once appreciated if it is realized that a 12 cylinder engine which revolves, say, at 1,500 revolutions per minute requires 9,000 sparks in the same period of time. The armature, contact breaker and condenser must, therefore, rotate at 4,500 r.p.m. To-day in the case of modern aero engines, revolutions numbering over 2,000 per minute can, however, be regarded as normal and the possibility that the number of revolutions may be increased to 3,000 in the not very distant future is not to be dismissed, in fact this figure is even now attained in isolated cases at the peak. In this connection 1,800 sparks per minute must be produced, and the magneto with rotating armature must therefore make 9,000 revolutions.

In addition to this there is the fact that now-a-days in the majority of aero engines a very long, multiple throw crankshaft of small diameter is used, which tends to unusually marked oscillations. The magneto and its driving parts are subjected to these oscillations and particularly so when, as is now usual, the magneto is not driven off the air propeller end of the crankshaft but off the opposite end.

A magneto can only stand up to these multiple and very considerable stresses due to high speeds and oscillation, providing the rotating inductor demands a low driving speed, is of light weight and small diameter, possesses the lowest possible moment of inertia and is particularly resistant to vibrations.

The past has shown in many instances that in the construction of an aeroplane or airship the most essential part is the safe running of the motors. That there is no faultless running of the magnetos, spark plugs, oilers and so forth. Without these the best constructed ship would be worthless and cause loss of lives.

Another improvement produced by the Bosch Works are the starting magnetos. Previously, aero-engines had to be set in motion by rapid rotation of the air propeller, causing very frequently accidents. With this new invention, the Pilot can start the engine from his seat by rotating the hand crank of the starting magneto.

The Robert Bosch Company is the largest factory in this line on the Continent, with service stations and distributing offices all over the world. They maintain a special department recording all the experiences of the pioneers in the air and have improved their equipment year by year by co-operating with the air pilots and mechanics studying to extend where air improvements have been made. The first high tension magneto was built in 1924, if compared with the 1930 type, it shows what improvements have been made and the success attained.

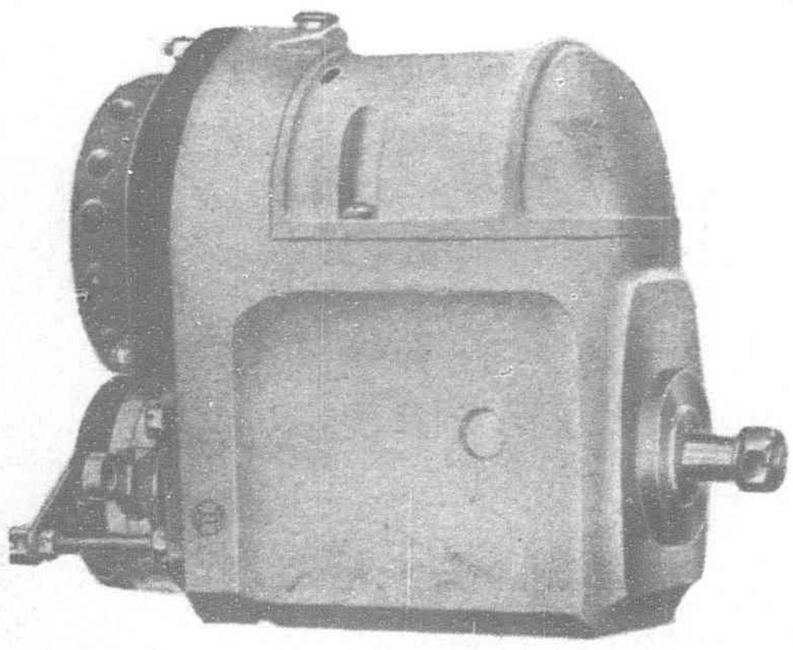


Fig. 1.—Magneto GF 12A, (Driving end)
(1/3 full size).

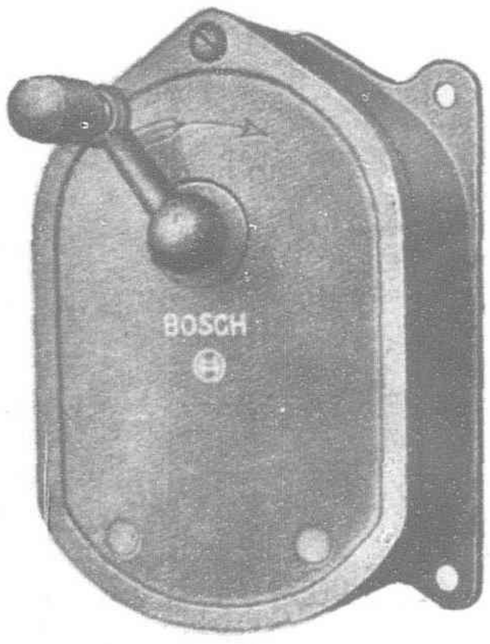


Fig. 19.—Starting Magneto
(1/3 full size).

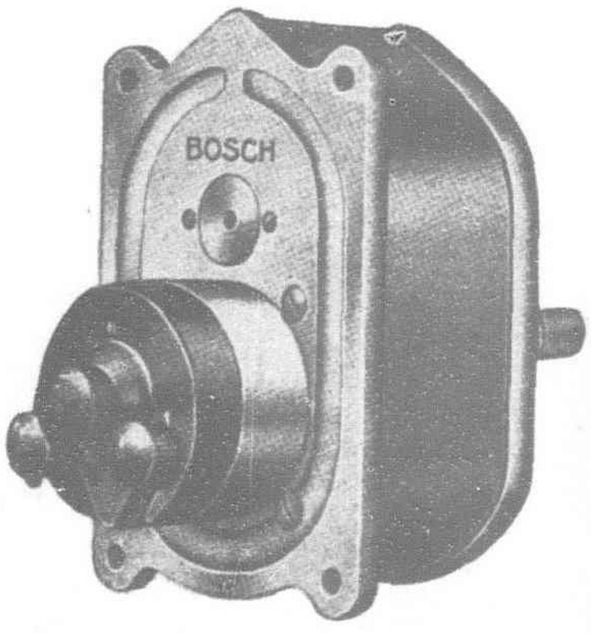
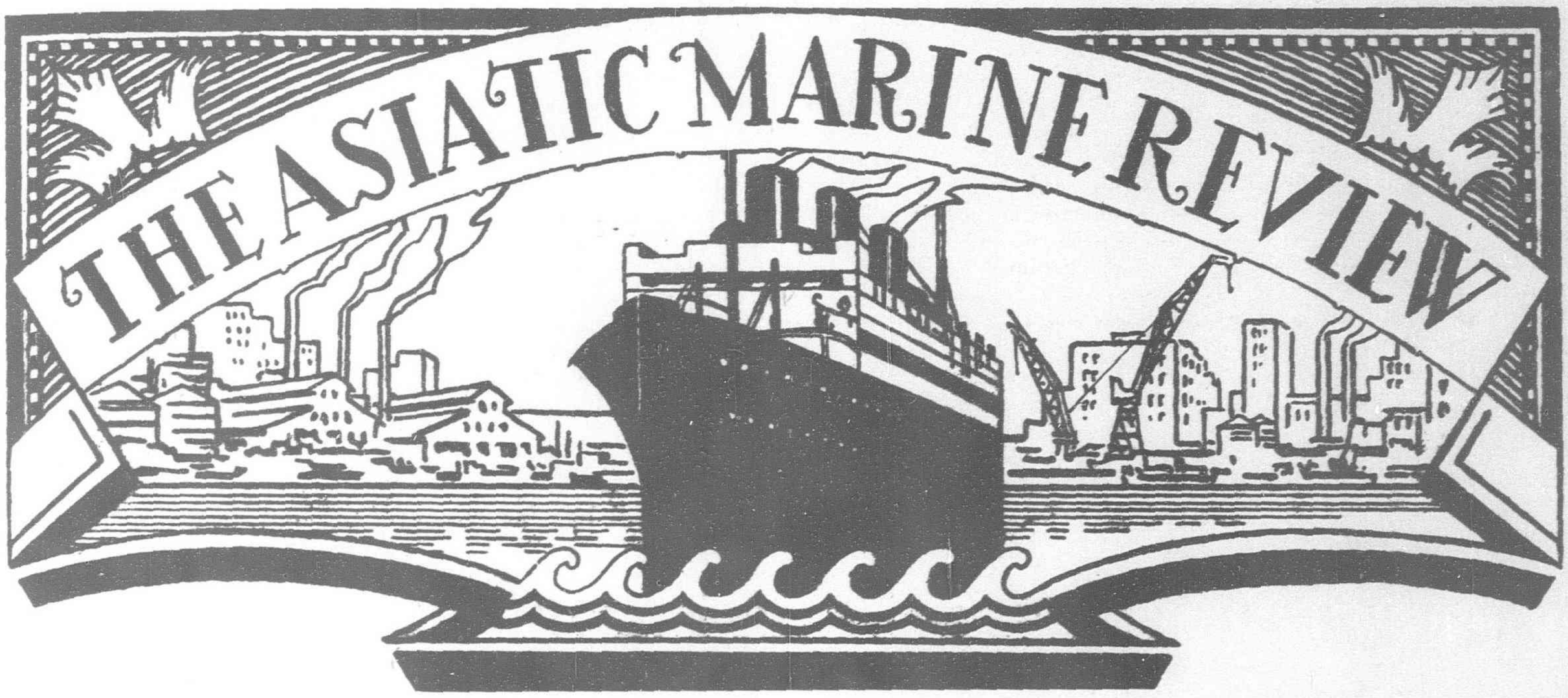


Fig. 20.—Starting Magneto WZ 11435
(Rear view).

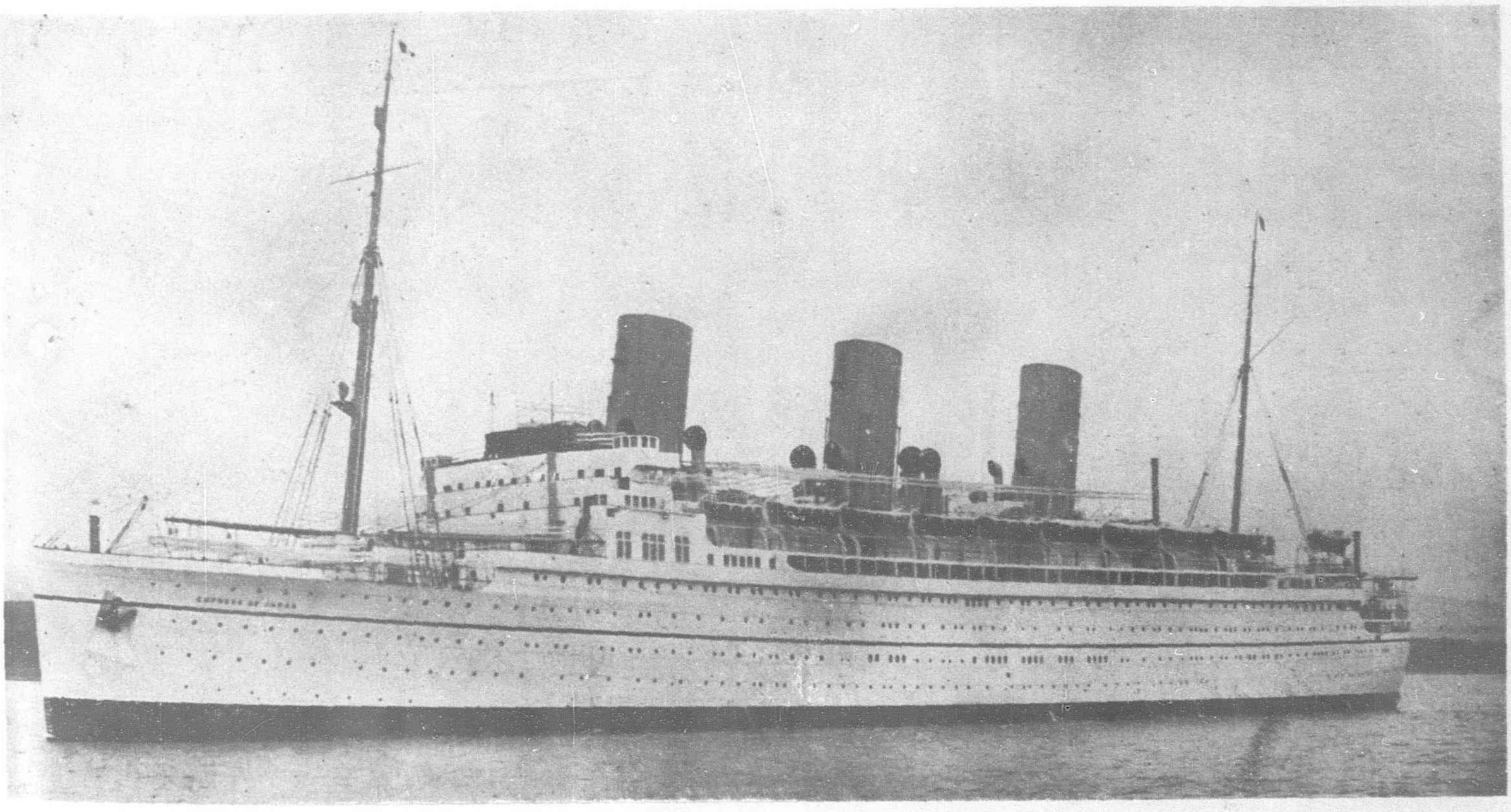


"The Queen of the Pacific"

The New C.P.S. 26,000 Ton Geared Turbine-Driven Twin-Screw Pacific Liner, "Empress of Japan"

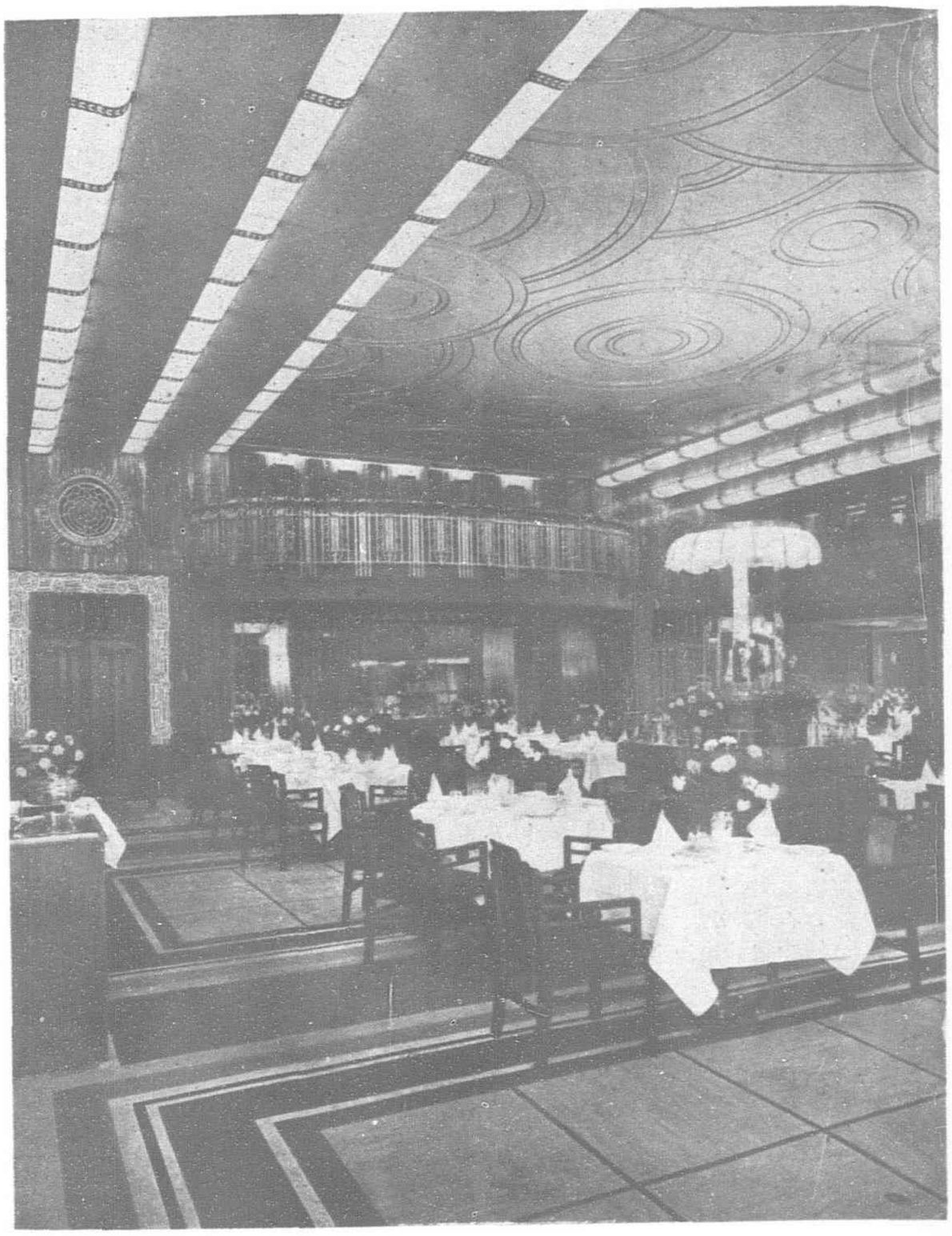
Built and Engined by the Fairfield Shipbuilding & Engineering Company, Ltd.

THE C.P.R. has again demonstrated its determination to maintain its supremacy on the Pacific by building one of the largest, fastest, and most luxurious liners for this traffic. The 26,000 ton liner, *Empress of Japan* built and engined by the Fairfield Shipbuilding & Engineering Company, Ltd., of Govan, Glasgow, now on her maiden voyage to the Orient, represents the very last word in luxury, comfort and safety, a tribute to British engineering genius and to the enterprise of a company who, since its entrance into the Pacific shipping business, has set a standard for service, speed and reliability that has never been surpassed by any of its competitors. The fight for the trade of the Orient is growing more and more intense with the rapid

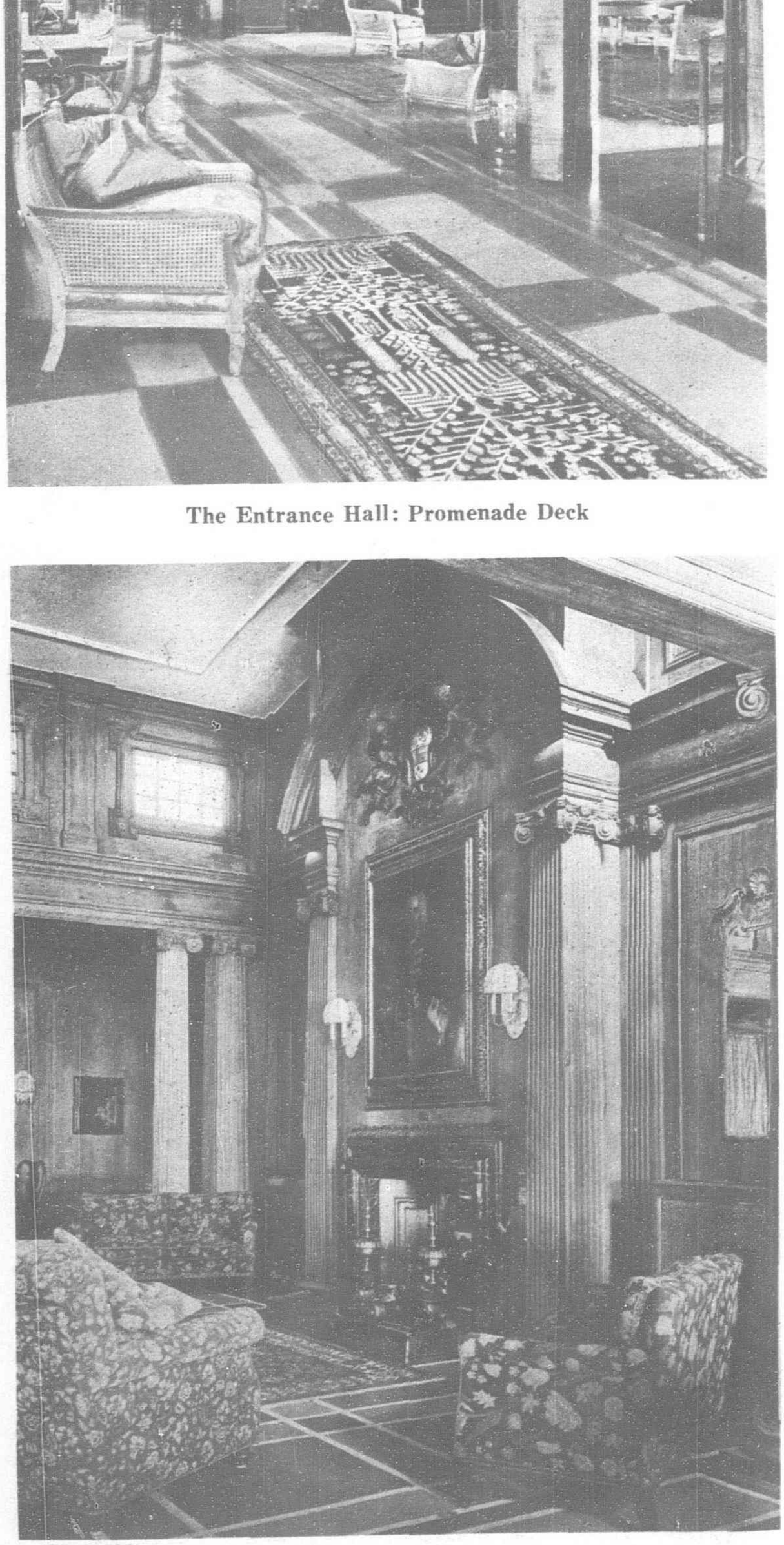


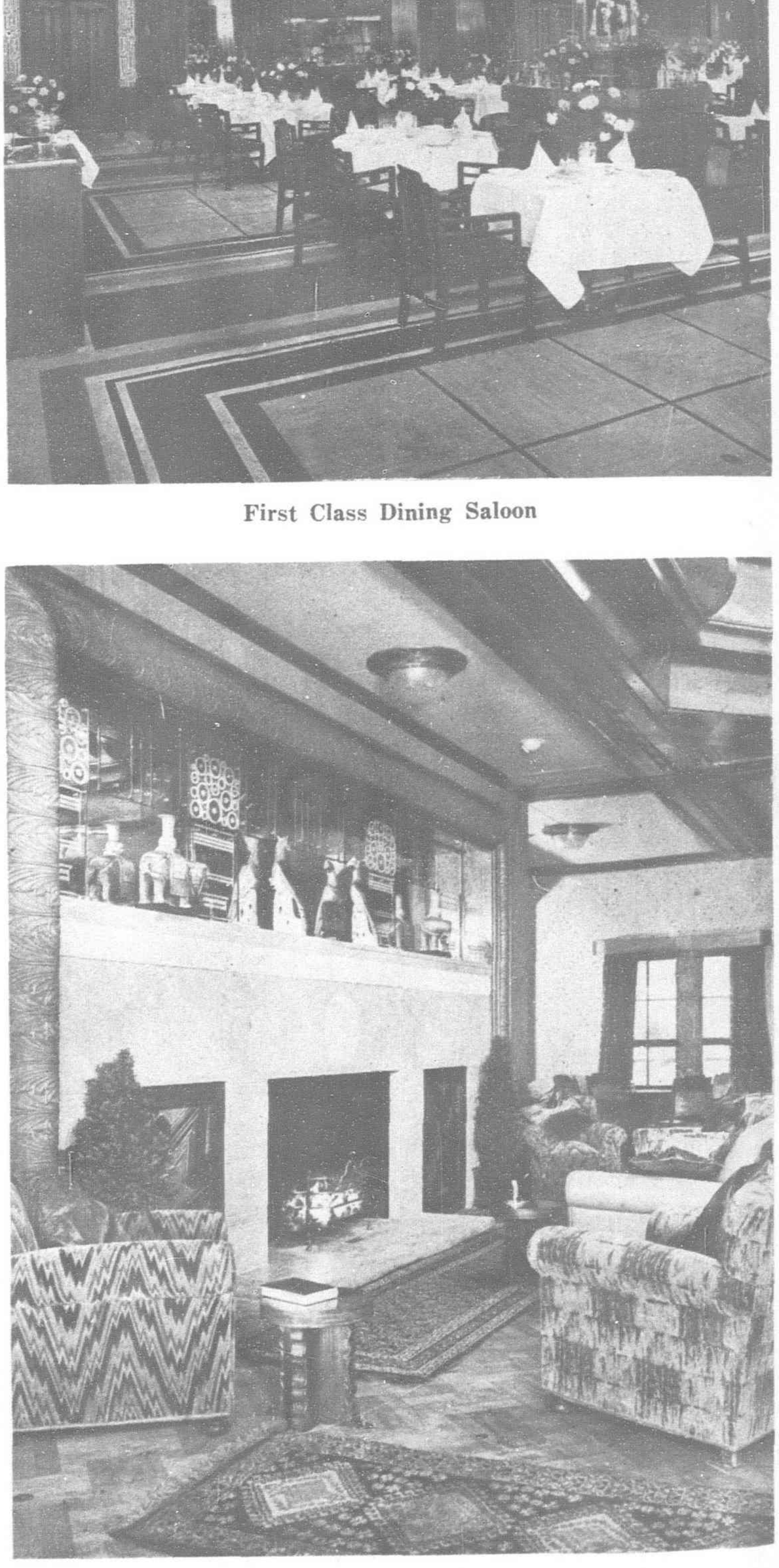
Canadian Pacific Liner, "Empress of Japan"

The Entrance Hall: Promenade Deck



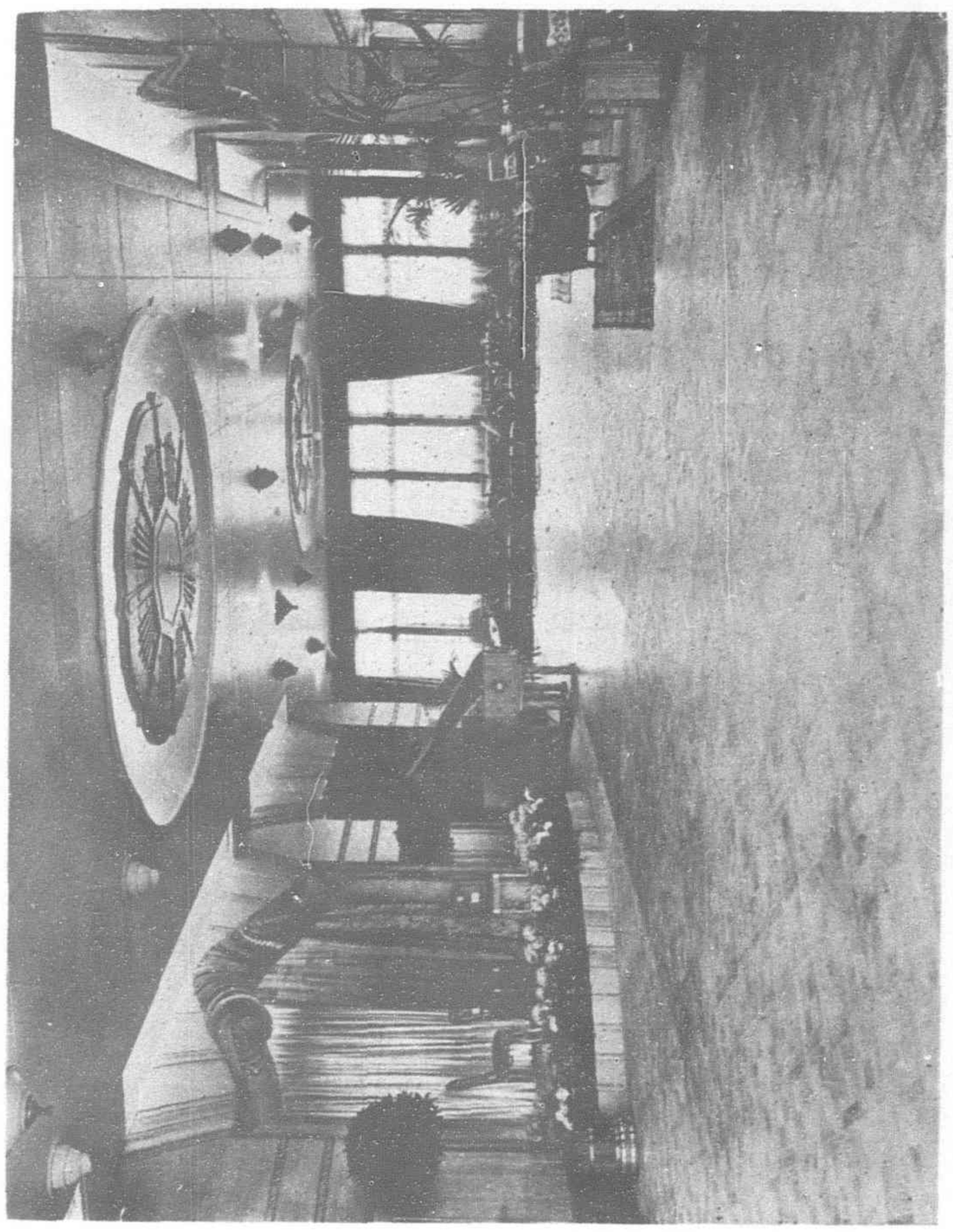
First Class Dining Saloon



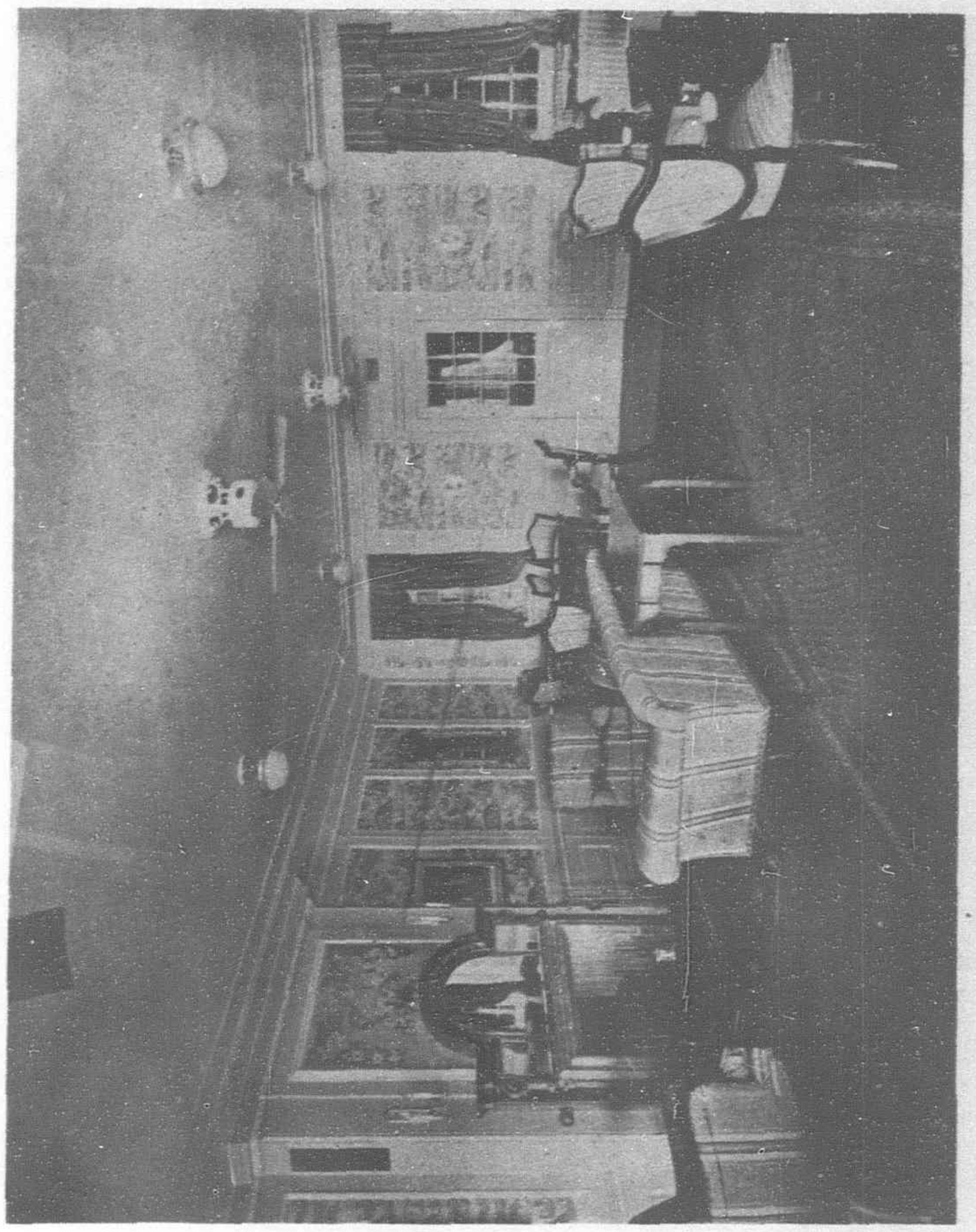


First Class Smoking Room

LUXURIOUS ACCOMMODATIONS OF THE "EMPRESS OF JAPAN."

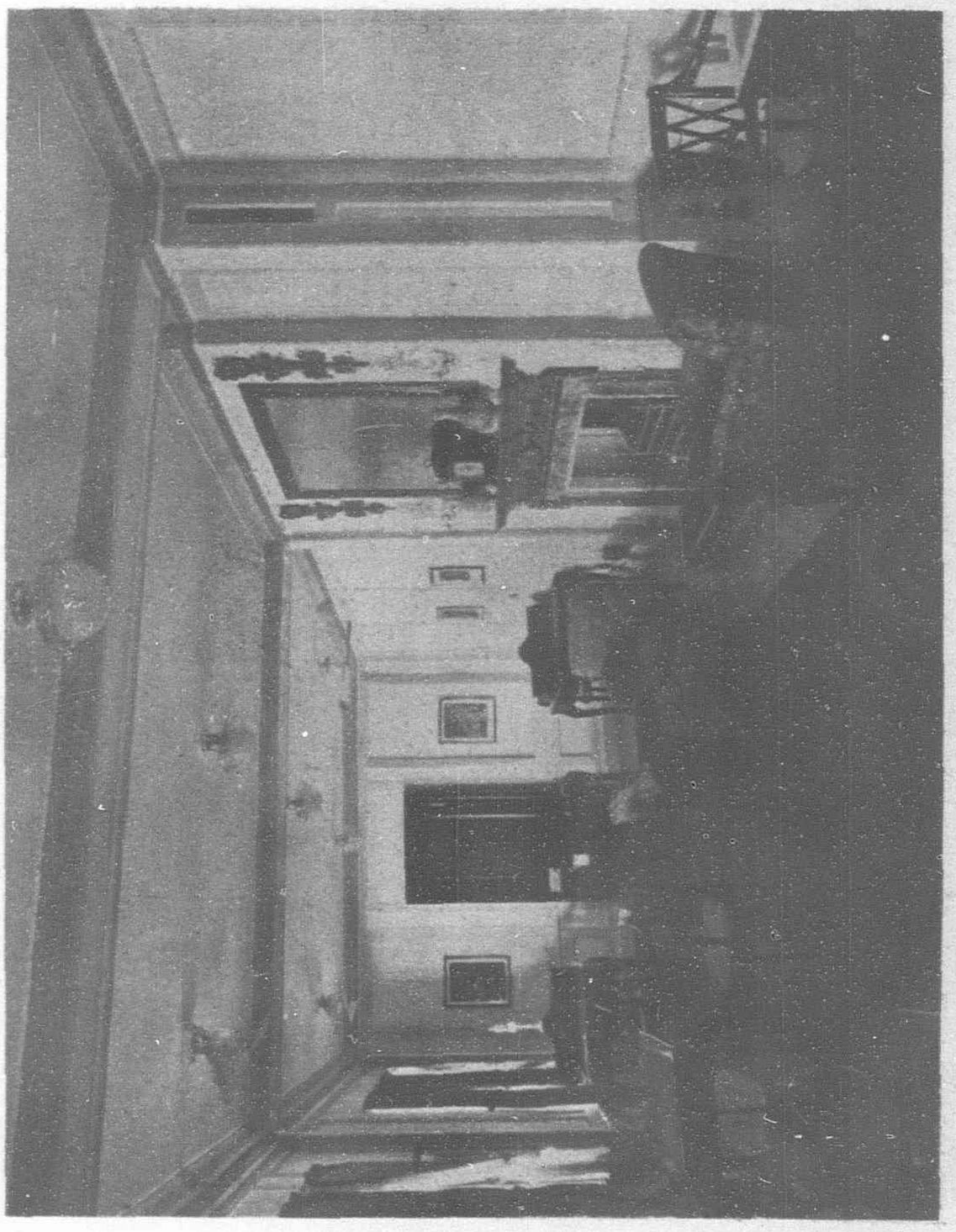


The Saloon Court



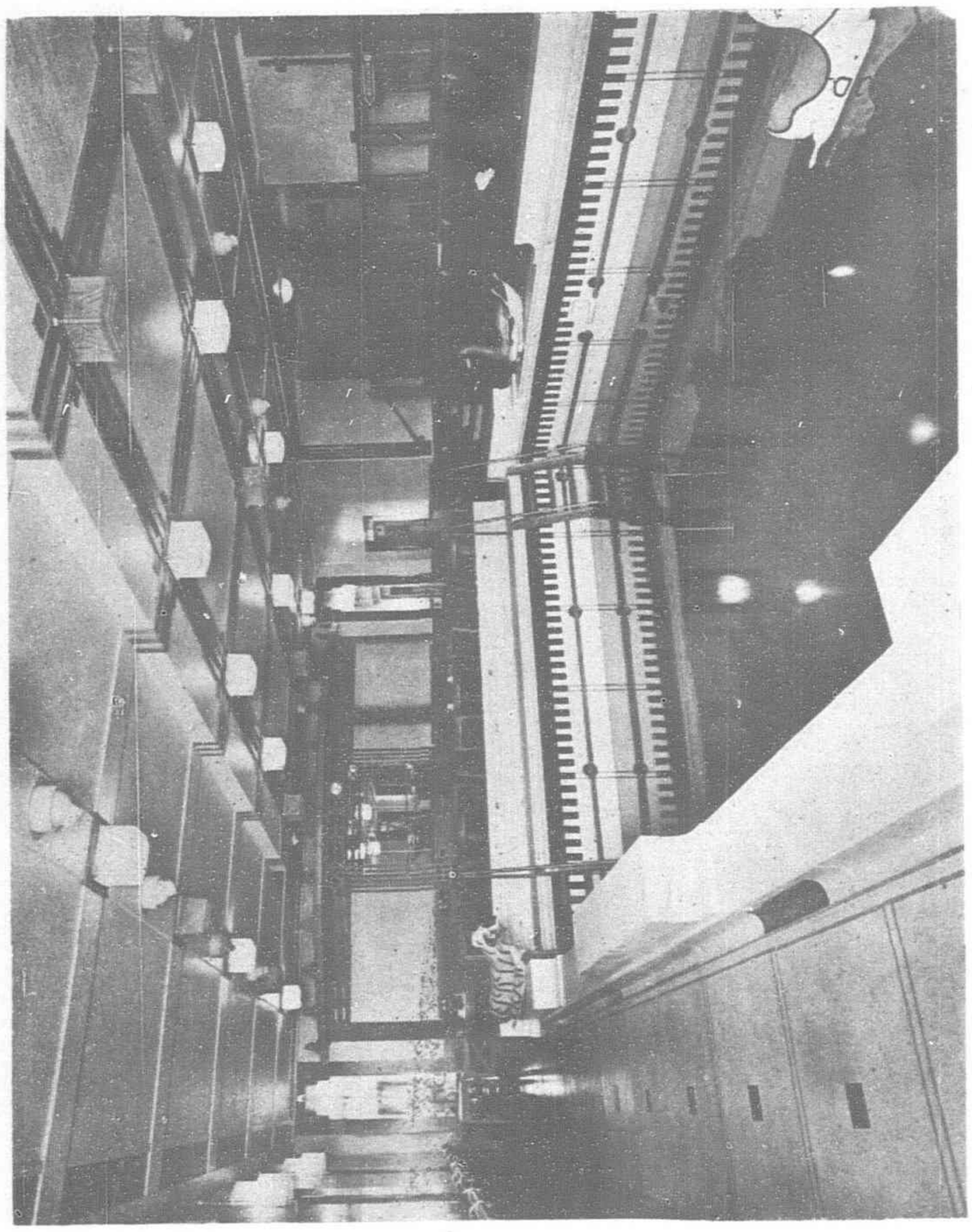
First Class Drawing Room

First Class Lounge

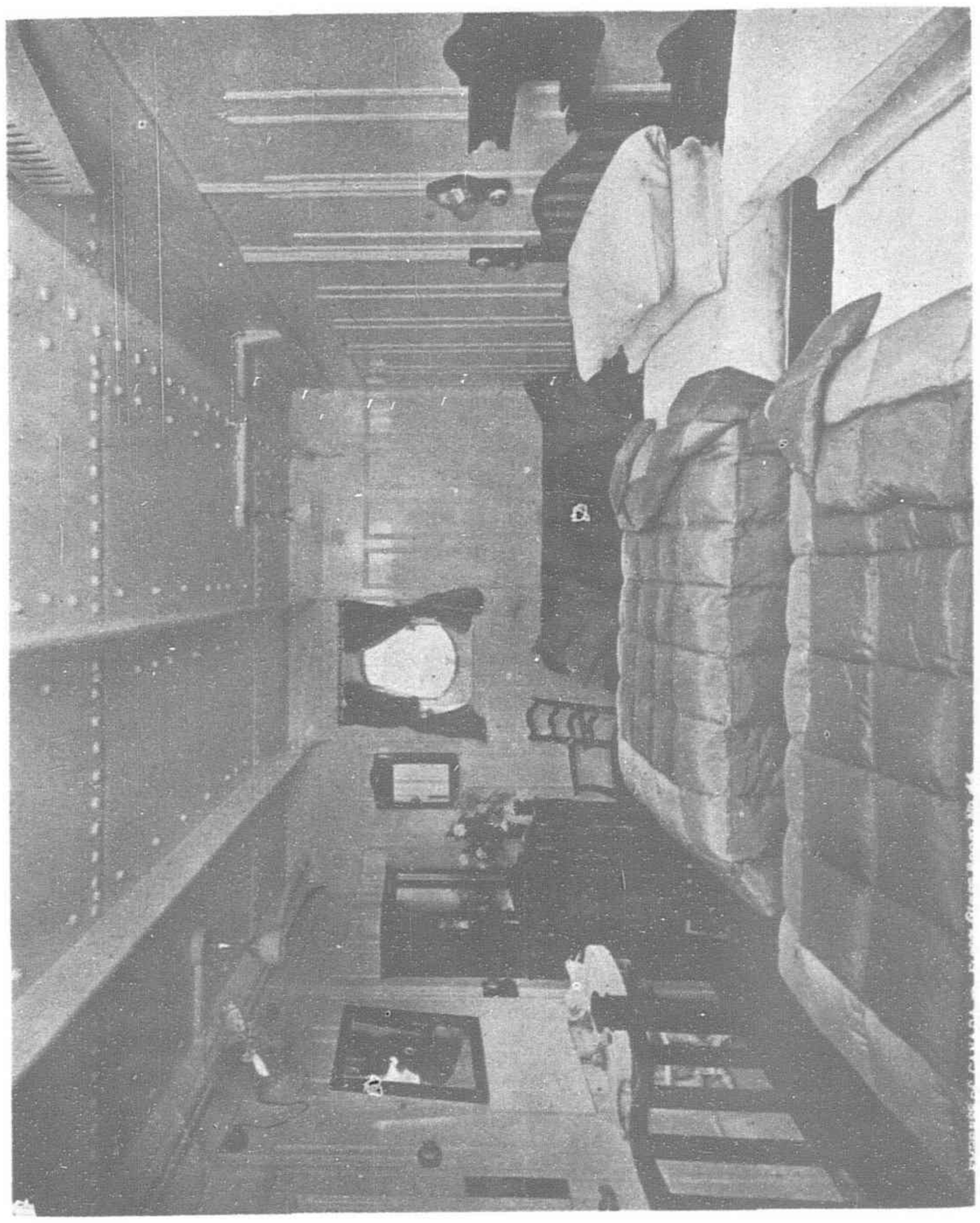


Writing Room

LUXURIOUS ACCOMMODATIONS OF THE "EMPRESS OF JAPAN."

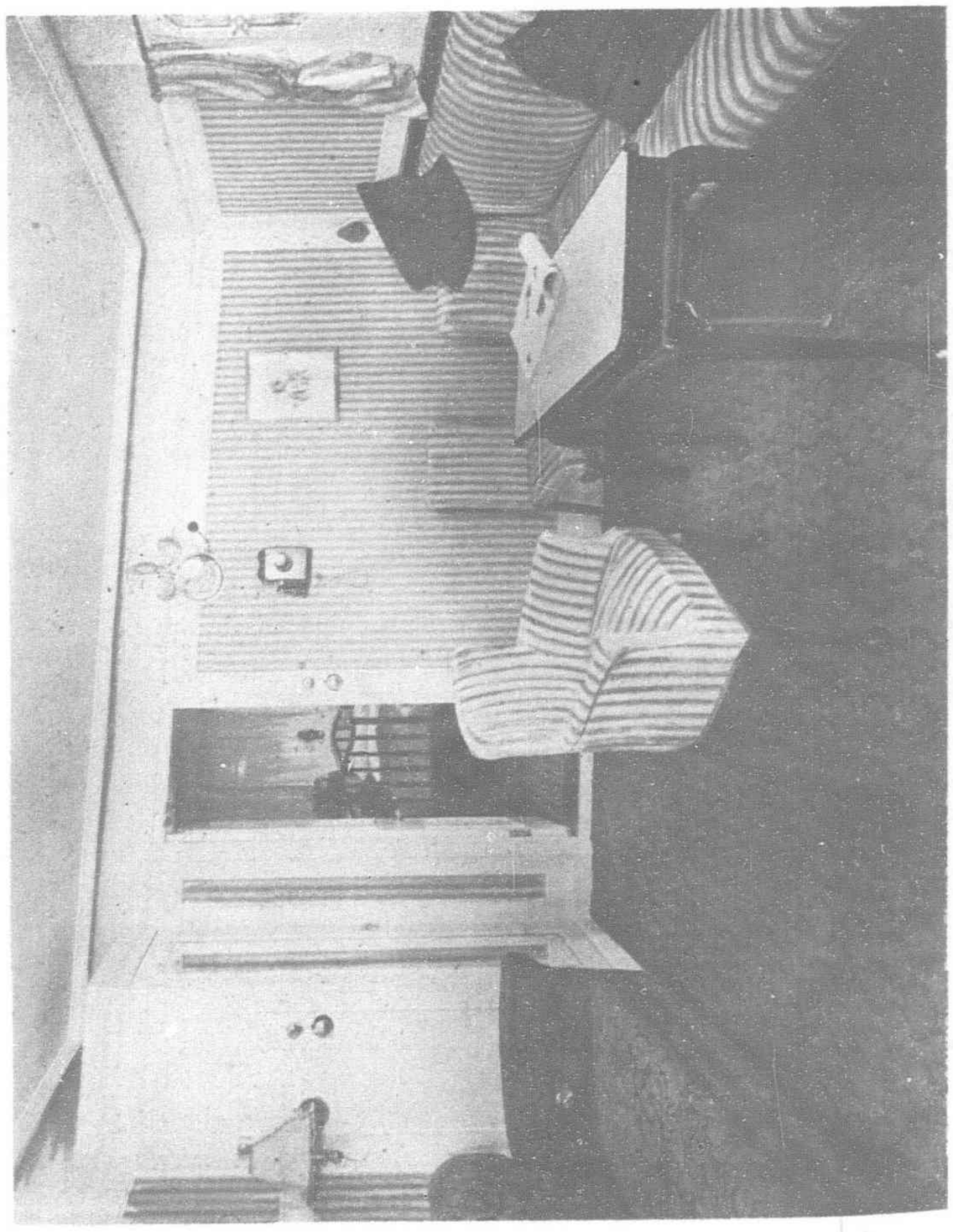


Swimming Pool

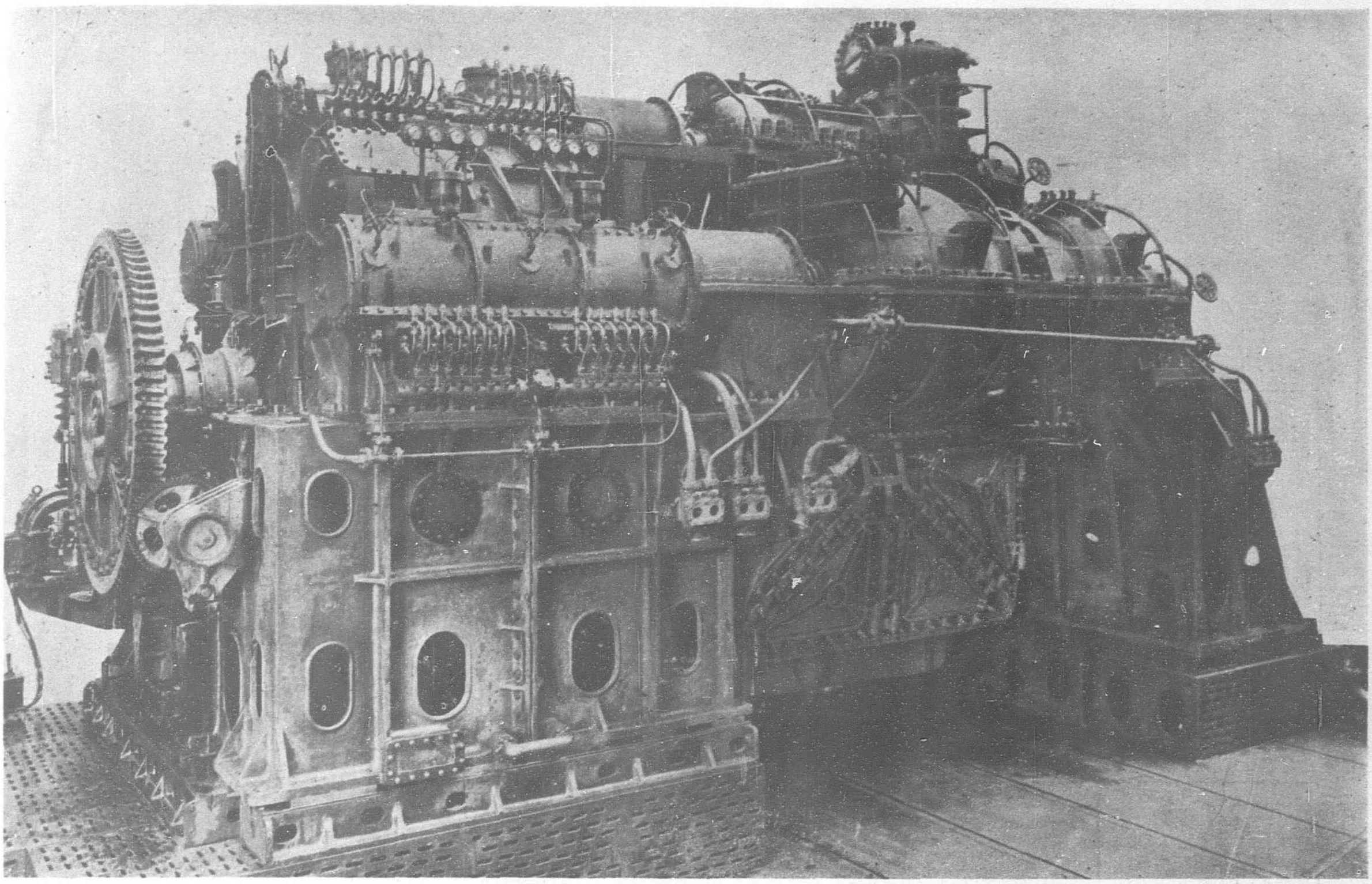


First Class Stateroom, No. 44

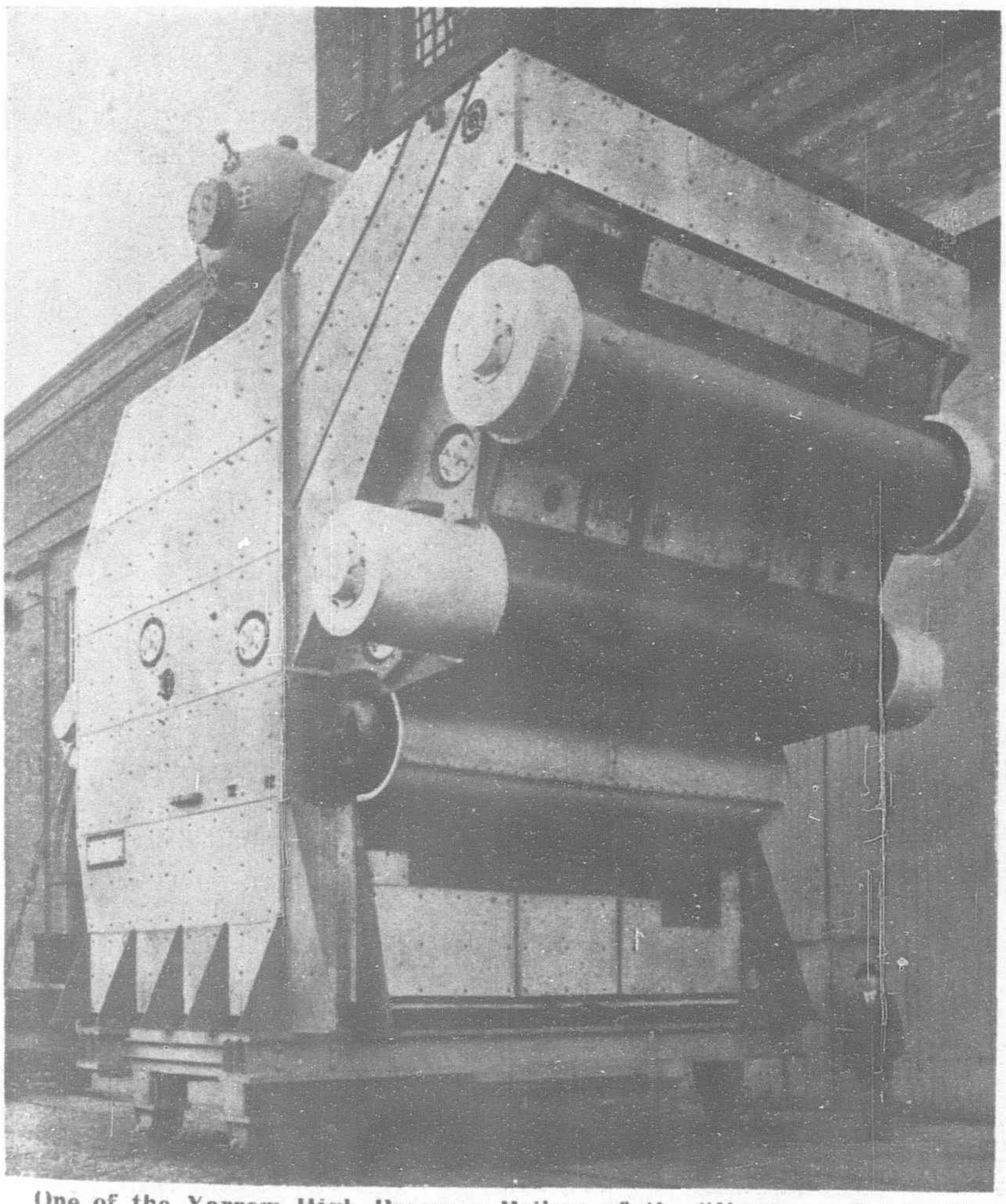
First Class Dining Saloon



First Class Stateroom, Suite No. 71



One of the Two Sets of Single Reduction Parsons-Type Geared Turbines for the "Empress of Japan"

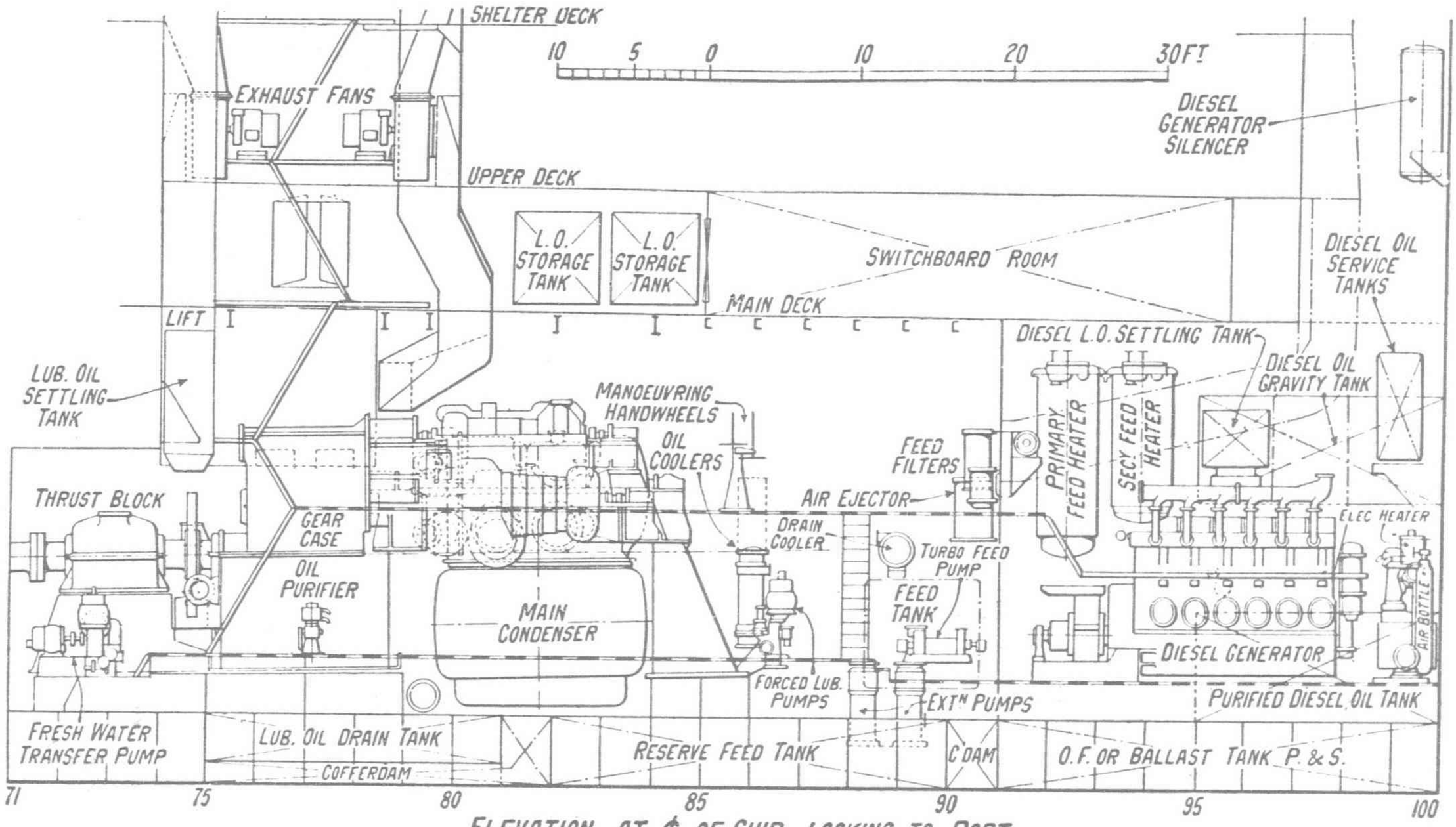


One of the Yarrow High Pressure Boilers of the "Empress of Japan"

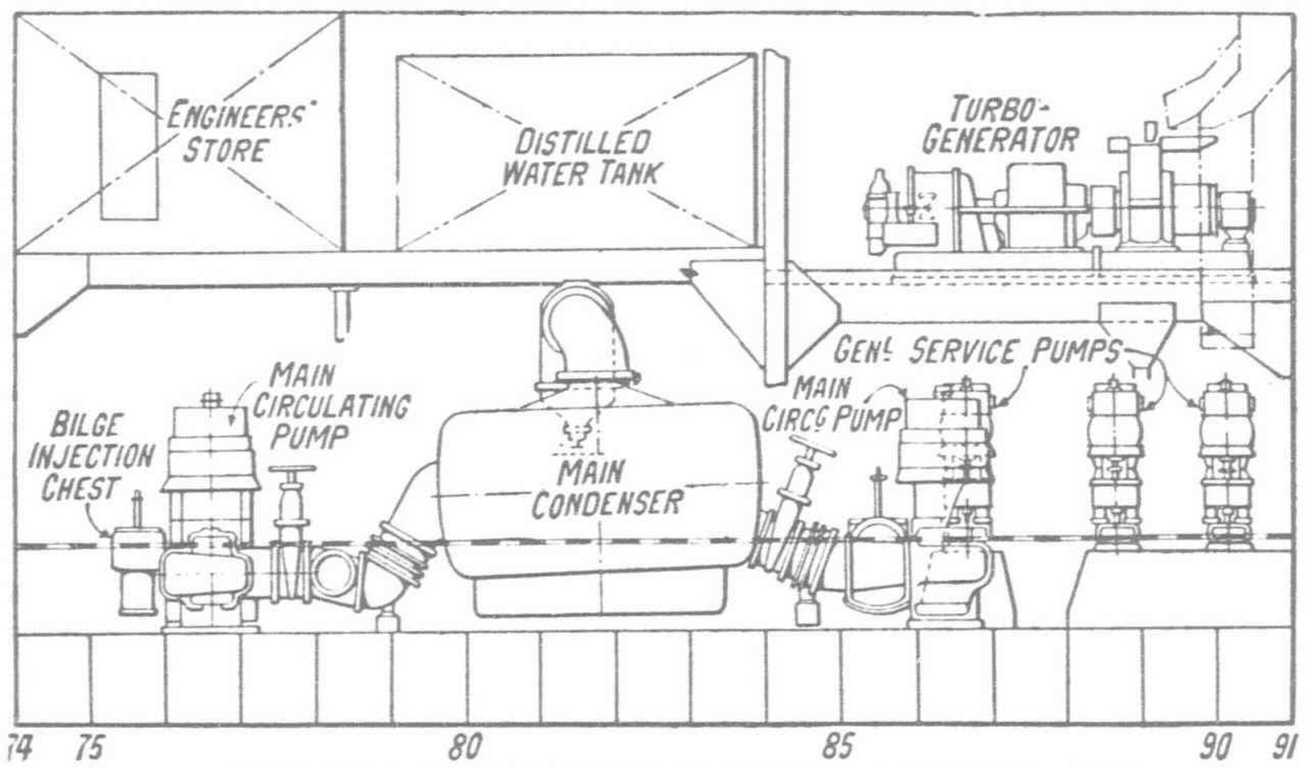
development of trade and travel and only those shipping companies who offer the best accommodation and speed can hope to hold their own in the bitter competition that looms ahead.

Japan has made a magnificent bid for her share of this traffic and the confidence of the travelling public by building and putting into service this last year the most luxurious and up-to-date motor liners on the Pacific. The Robert Dollar Company, in order to hold its premier position in American shipping on the Pacific, is also building a fleet of new passenger liners to replace the older ships designed during the war by the Shipping Board for other services. The first two vessels of the new Dollar fleet are now under construction at the yards of the Newport News Shipbuilding Company. The C.P.R. with its splendid and popular fleet is meeting this competition with vessels that typify the best that British shipyards can produce. The conversion of the machinery of the *Empress of Canada* from a nineteen to a twenty-two knot vessel to meet the requirements of the new acceleration program of the C.P.R. recently carried out by the Fairfield Shipbuilding & Engineering Co., Ltd., has made possible a service speed for the C.P.R. liners that is difficult for its competitors to surpass. The present Canadian Pacific fleet in the Pacific Ocean consists of the *Empress of Canada*, 21,500 tons; *Empress of Russia*, 16,800 tons; *Empress of Asia*, 16,800 tons and the *Empress of Japan*, 26,000 tons. The total gress registered tonnage of the Canadian Pacific ocean and coastal steamships now in operation, including those vessels under construction, is nearly 519,000 tons.

Since 1919, the Canadian Pacific Company has spent £20,000,000 in building sixteen new steamships, the latest being the *Empress of Britain* recently launched by H.R.H. the Prince of Wales. Forty-three years ago, in 1887, the Canadian Pacific Railway made its appearance in the Pacific trade with three chartered ships for the Vancouver-Orient run. Three years later, the C.P.R. concluded its first contract with the British Government providing for a



ELEVATION AT ℄ OF SHIP, LOOKING TO PORT.



ELEVATION AT 24'.0" FROM ℄ OF SHIP, LOOKING TO PORT.

Elevation of the Engine Room of the "Empress of Japan"

mail subsidy of £60,000 a year and to fulfil the terms of the contract, the first three "Empress" liners of 6,000 tons each were specially built. From this date the company has built its own ships, each one specially designed for the service, each new type being bigger, faster and more luxurious, carrying into the Pacific the same standards of comfort, speed and service that prevails on the crack Transatlantic liners.

The C.P.R. is a British institution, a link the chain of Britain's All-Red communications around the world, but it is just as much an American enterprise as though operated under the Stars and Stripes. Probably as many Americans patronize the line and its steamships carry as much American cargo as they do Canadian or British, and despite the intense appeal to Americans to travel on American ships, the Empress liners have held their own in the competition for the American passenger and cargo trade. The clock-like schedule maintained by the C.P.R. on its Trans-Pacific run has set an example of regularity in arrival and departure from the various ports of call, that other steamship lines have been compelled to follow.

By dint of hard, up-hill, persevering work, splendid performance, regularity, courtesy, safety and special attention to the wants of the passengers, the Empress liners have built up a reputation in the Pacific surpassing many of the more majestic floating palaces who cater to the luxury traffic across the Atlantic. The C.P.R. is in the Pacific to stay. No matter how keen the rivalry, it can be counted on to keep at least one hop ahead of its competitors in the size, speed and appointments of its vessels.

The latest addition to the C.P.R. Pacific fleet is typical of that spirit of progress that within the next two decades, will be called upon to supplant the vessels of to-day with luxurious floating palaces for the Pacific as large as those now operating on the Atlantic. Although the United States has awakened from her Rip Van Winkle half century inactivity on the seas and is now forging ahead to the second place in maritime importance, she will have to step lively and dig down deep into the national treasury to furnish the loans for new construction that will enable her to keep in step with her Canadian rival on the Pacific. The C.P.R. group are wide-awake, keen, hustling and on the job, overlooking nothing that will better its service.

Introducing a New Empress

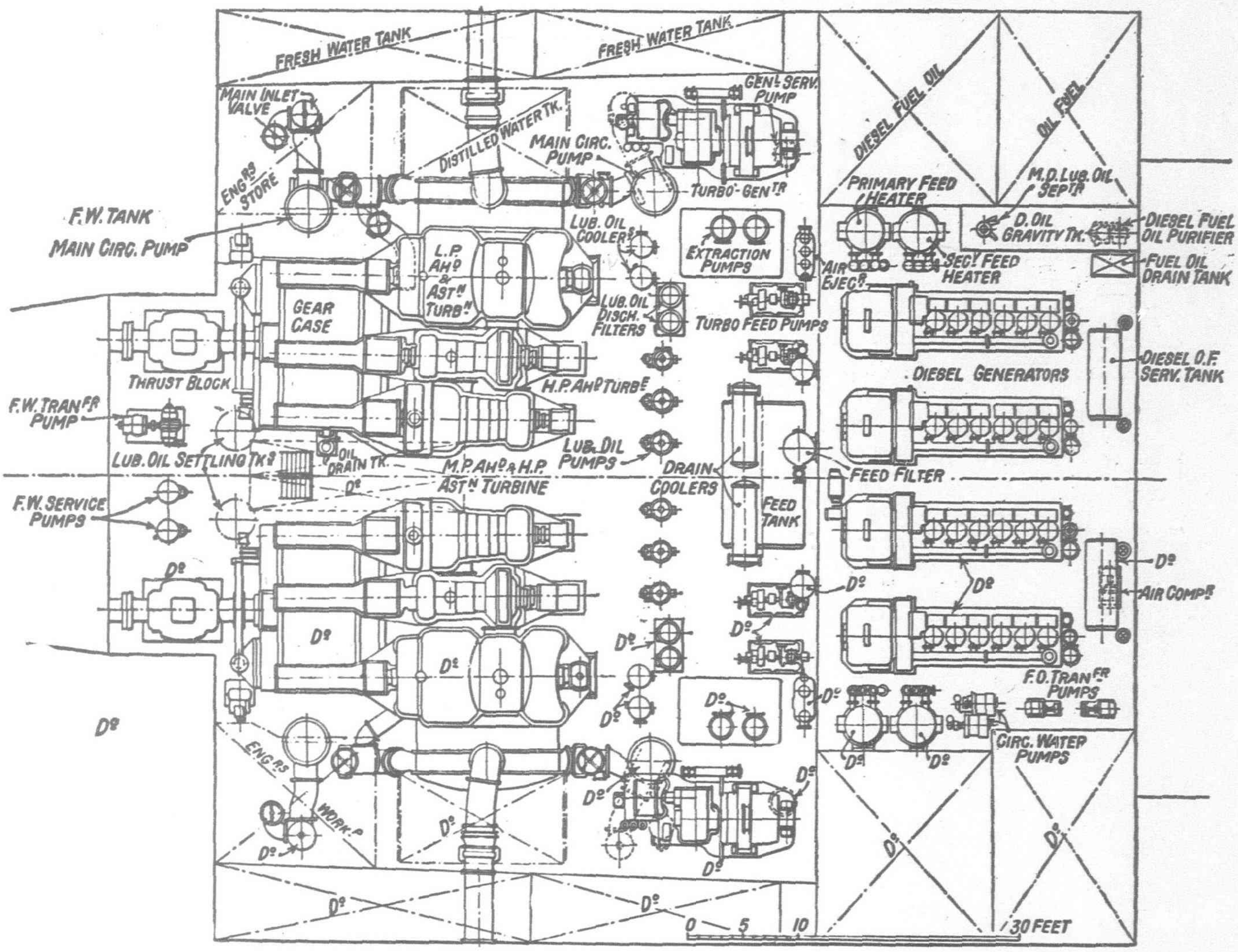
The Twin-Screw Geared Turbine Passenger Steamer *Empress of Japan* built by the Fairfield Shipbuilding & Engineering Co., Ltd., Govan, Glasgow, to the order of the Canadian Pacific Railway Company for their Transpacific Service, forms the most important addition yet made to that Company's fleet.

The *Empress of Japan* has been designed by the Fairfield Company to meet the Owners' requirements for her intended service in accordance with arrangement plans supplied by them and will be the largest and fastest Mail and Passenger Steamer running on the Pacific. She has been constructed under the supervision of Messrs. C. S. Douglas & Co., Glasgow.

The principal particulars of the vessel are :—

Length overall	666 feet 0 inches.
Breadth at Promenade Deck	87 feet 9 inches.
Depth moulded to Bridge Deck ..	56 feet 9 inches.
Speed on Trials	23 Knots.
Speed on Service	21 Knots.
Gross Tonnage	26,032 Tons.

Passengers :—			
First Class	399	Asiatic Steerage ..	510
Second Class ..	164	Officers and Crew ..	579
Third Class	100	Total	1,752



Plan of the Engine Room of the "Empress of Japan"

The *Empress of Japan* has been constructed under special survey to Lloyd's Highest Class. The vessel is sub-divided in full accordance with the requirements of the Bulkhead Convention, and fulfils all the requirements of the International Conference on Safety of Life at Sea, British Board of Trade, Home Office Factory Act and American and Canadian Laws for High Class Passenger Vessels.

A prominent feature of the ship's external appearance is her three funnels. She has a straight stem, cruiser stern, two pole masts and is rigged as a fore and aft schooner.

The Navigating Bridges are at the forward end of the Sun Deck.

The stern is of cruiser form and is associated with a rudder of the stream line form, the main part of the hull ending on the face of the rudder to give a good stream line.

The main transverse watertight bulkheads extend to the Upper Deck and are ten in number.

The middle portion of the ship below the Main Deck—the lowest continuous deck—is occupied by the Turbine Room, Generating Room, Boiler Rooms, and Oil-Fuel Bunkers, the Ship being arranged to burn Oil Fuel.

The Boilers are placed in two separate boiler rooms.

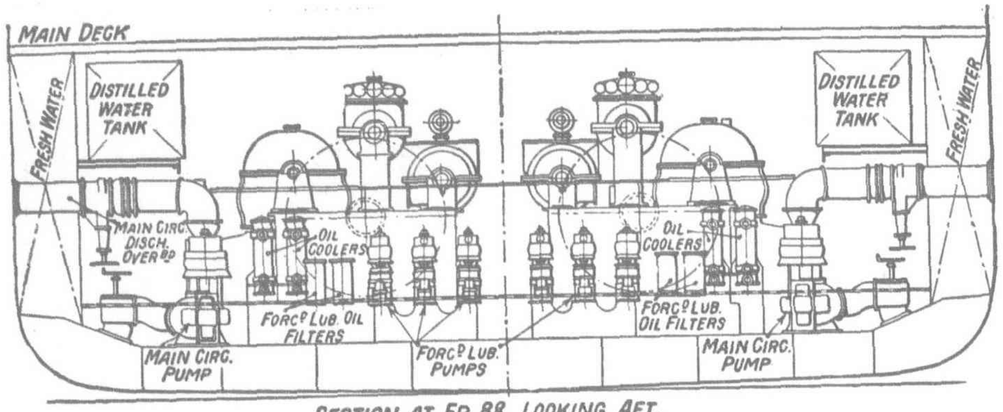
The double bottom is arranged to carry fresh water or water ballast and oil fuel or water ballast. Water ballast for trimming purposes or fresh water is also carried in the fore and aft peak tanks. Large fresh water tanks are built into hull of ship at side of engine room and shaft trunnels.

There are eight decks in addition to the Hold, Sun Deck and Navigating Bridges. The total height from the keel to the top of wheel house is 107 feet.

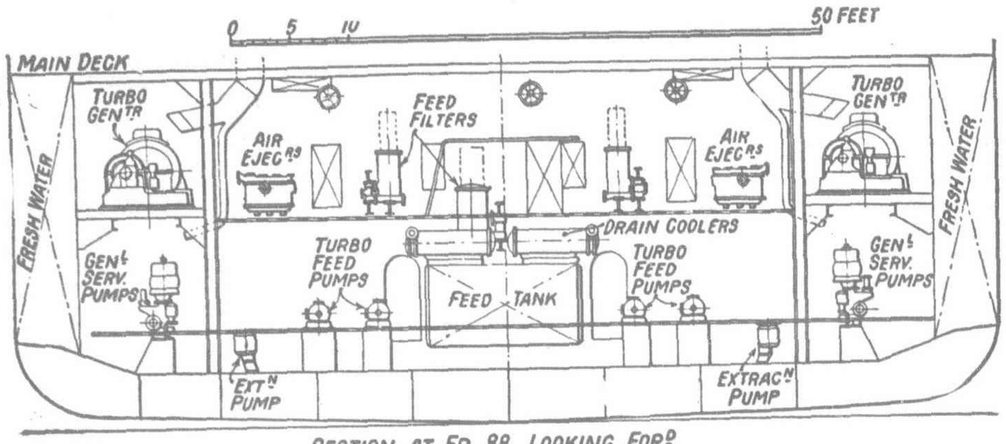
Verandah Cafe; "Empress of Japan"

On the Sun Deck are houses for service tanks and fire extinguishing plant, large dome skylights over the public rooms below, light and air trunks to the various compartments below, thermo tanks and fans for ventilation, leaving large open spaces which will be used as a sports deck. At the forward end is the Navigating Bridge with accommodation for Captain and Pilots with a large wheel house and chart room above.

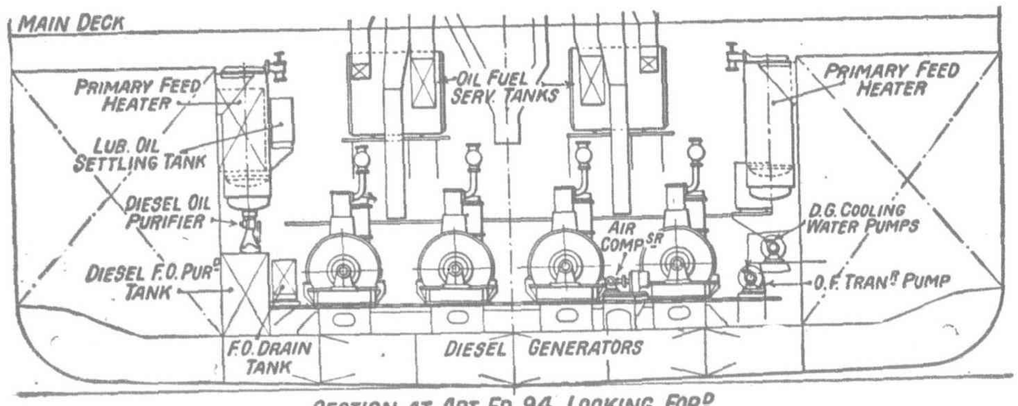
On the Boat Deck amidships house which is raised to give height to the Public Rooms there are 28 First Class Staterooms arranged for single, two or three berths. These rooms are large, airy and naturally lighted, having square brass windows on side of house, and fitted up with an open pedestal washbasin having hot and cold water led on, dressing table, fitted wardrobe, etc. The walls and passages are all finished in hardwood. Several of the staterooms have self-contained spray and W.C.



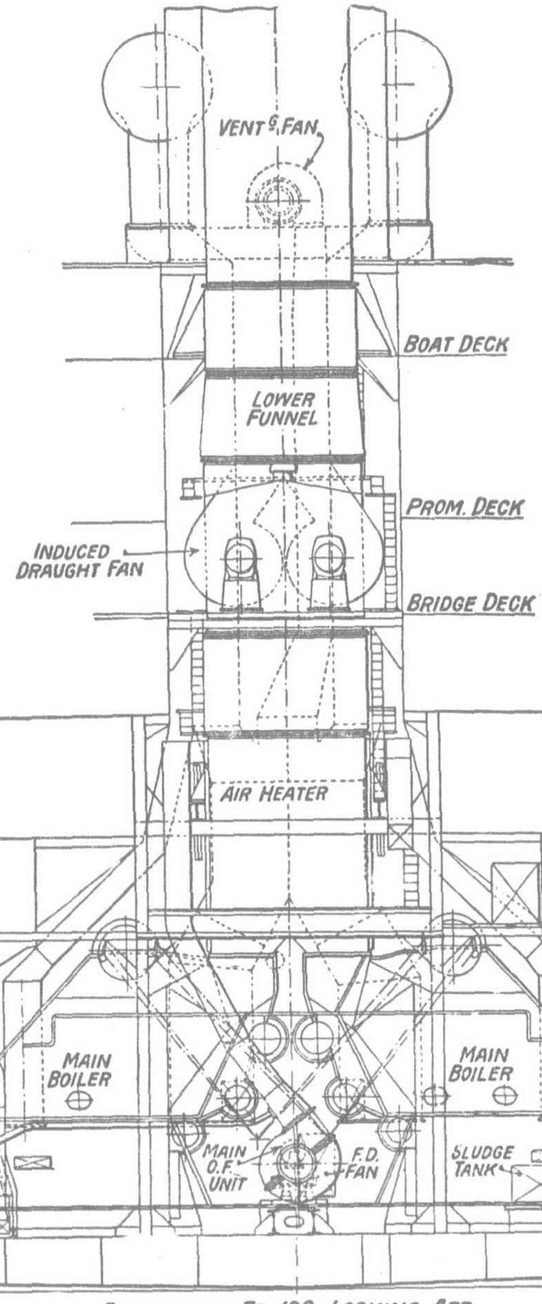
SECTION AT FR. 88. LOOKING AFT.



SECTION AT FR. 88. LOOKING FORD

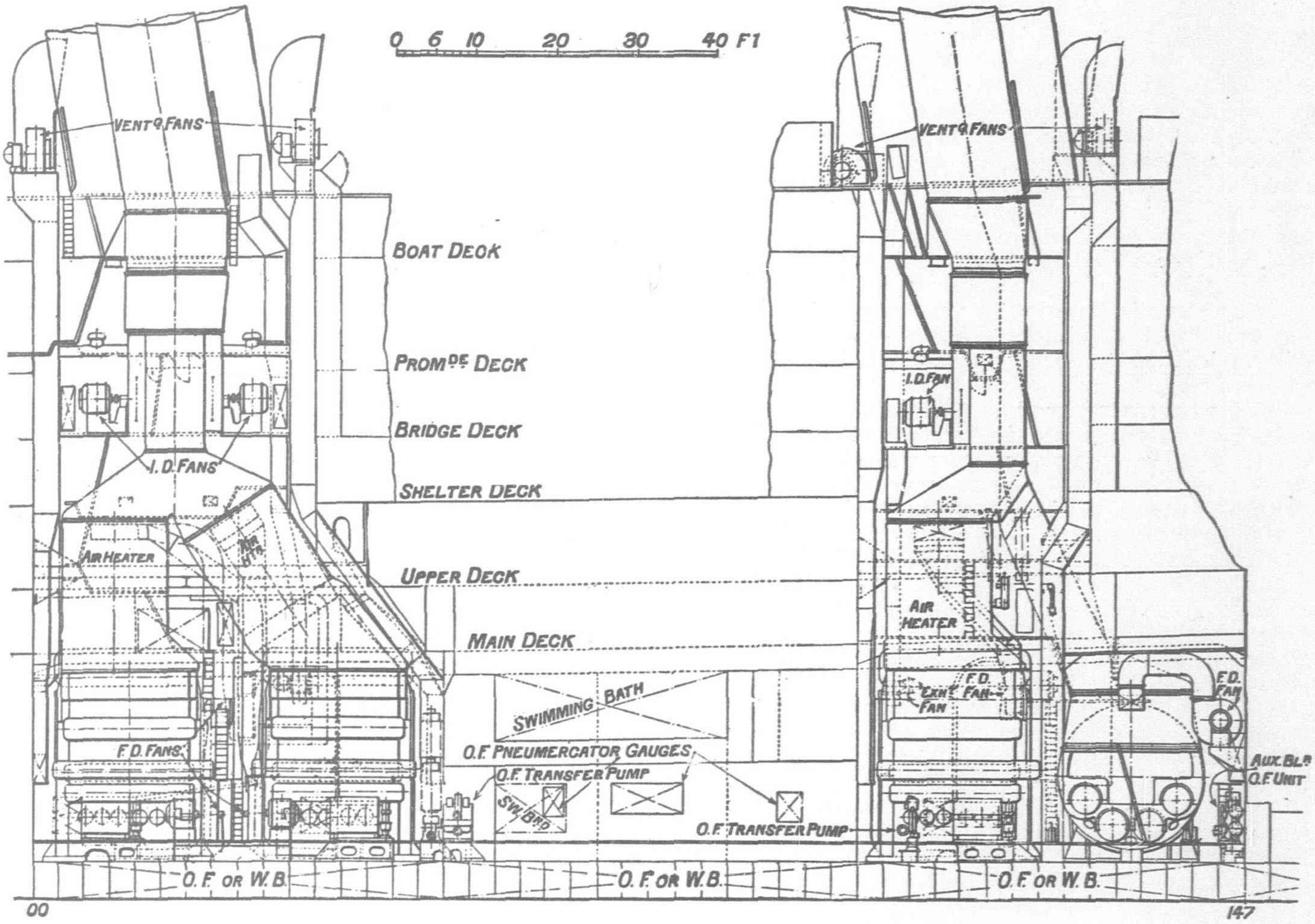


SECTION AT ABT. FR. 94. LOOKING FORD



SECTION AT FR. 108. LOOKING AFT.

Sections Through the Engine and Boiler Rooms of the "Empress of Japan" Built and Engined by the Fairfield Shipbuilding & Engineering Co., Ltd.



Elevation of the Boiler Rooms of the "Empress of Japan"

At the fore end of passenger accommodation a large Gymnasium is situated, fitted up with all the most modern gymnastic apparatus, adjacent thereto being a dressing room with wash basins, spray baths also lavatories.

At the forward end are arranged in a large steel house the Officers' Quarters and Wireless Offices.

The sides of Boat Deck can be used as a promenade for passengers in fine weather and extend two feet each side over the full width of the vessel.

On the Promenade Deck the First Class Public Rooms are located, *viz* :—The Palm Court and Ball Room, Long Gallery and Main Entrance Hall, Writing Room, Card Room, Empire Lounge, Smoking Room, Verandah Cafe and Children's Room.

The Palm Court and Ball Room. The walls are panelled in natural oak enriched with gilding, open on three sides—port, forward and starboard—to wide sea views seen through broad windows half screened by palms and flowers. The electric lighting concealed in the richly decorated ceiling is capable of instantaneous color changes. A Band Platform, also a large Soda Fountain of the latest type, is at after end.

The Long Gallery and Main Entrance Hall communicating aft with the Smoking Room and forward with the Palm Court, is executed in ash and walnut picked out in gilt, glass doors lead amidships into the Main Entrance Hall.

The Shop, attractively designed with colonnades, occupies a central position facing the Staircase panelled in ash and walnut and flanked by massive carved balustrades. Revolving doors lead to the open deck and Passenger Elevators to the various decks are easily accessible from the Main Hall.

Off the Main Entrance Hall are the Writing Room and Card Room, for both of which a painted treatment has been chosen. The walls are panelled in the early Georgian manner and painted cream in the writing room and light coral in the card room, soft subdued lighting reflected from a coved ceiling falls on the elegant mahogany furniture and the marble chimney piece.

The Lounge is a bright and stately creation of Empire Style in pale wood and gold and blue brocade furnishings, a stage for concerts, screen pictures, and so on is at one end while the polished floor provides excellent dancing.

The Smoking Room with an inlaid teak floor and walnut skirting contrasting with specially selected light grained mahogany framing—studded with bronze nails to obtain a trellis effect—gives the room a warm and genial tone. An outstanding feature is the monumental chimney piece of carved Roman stone, crowned with a cut glass overmantel.

The Verandah Cafe. The walls are faced with composition covered out to stone courses. Large windows are arranged on three sides having overhead bronze metal balustrading for plants and flowers.

The Children's Room will be a very popular attraction where a doll's house appears as a red-tiled cottage standing in a painted flower garden. A large assortment of wonderful toys are provided also sleeping cots hidden in a curtained bower at one end.

Forward of after screen bulkhead is an open deck space which can be utilized in fine weather as a Promenade where there is a clear track 18 feet wide on each side of deckhouse. This deck also extends two feet out side over the full width of the vessel.

In the Deck House Aft on the Promenade Deck is the Second Class Smoking Room panelled in Austrian Oak and having a large fireplace at one end and glazed screen the other. A large skylight is overhead and Entrance Hall with bar and lavatory also wide Stairway is adjacent. The open deck space is a promenade for passengers.

Large public Lavatories and public bath rooms as well as a number of private bath rooms are arranged throughout the passenger accommodation. Service pantries are arranged on the various decks, there are also information bureaux, shops, offices, bars, dark rooms, etc.

On the Bridge Deck there is a large Entrance Hall, two *de luxe* Suites, 12 Special Rooms and 61 First Class State Rooms. The *de luxe* Suites comprise bedroom, sitting room, verandah with large square windows through ship's side, also entrance hall, bathroom and box room adjacent. Arrangements are provided whereby adjoining staterooms may be included *en-suite*. Special

Rooms, six of which are panelled in walnut and the other six in birch and black bean—comprising bedroom and bathroom are provided and may be included *en-suite* with adjoining staterooms. The First Class Staterooms are arranged with single, two and three berths. The rooms are large and airy and the walls are panelled in hardwood. All the lighted naturally having large sidelights on ship's sides. Each room is fitted with open pedestal washbasins having hot and cold water, dressing tables, fitted wardrobes, settees, etc. Several of these staterooms, have self-contained spray and W.C. Bedsteads are fitted in each room and arrangements are provided for fitting portable upper berths as necessary. Barber's Shop and Ladies' Hairdressing Salon with Manicuring or Chiropody Saloons are arranged in the passenger accommodation and fitted up with the latest appliances. The Surgeon's Apartments are also in proximity to the passenger accommodation and comprise bedroom, consulting room and operating theater, the latter being fitted up with all the latest surgical appliances.

On the Forecastle Deck are the Capstans and Cable Holders, and abaft the breakwater is a steel house enclosing the Entrance to the Steerage Quarters on the decks below. The forward part of the deck also affords an airing space for the Asiatic Steerage Passengers in fine weather.

In the Deck House Aft on the Bridge Deck is the Second Class Lounge panelled in selected cedar picked out with gold, a large fire place being at one end and glazed screen the other. Entrance Hall with a specially fitted up Shop also lavatory and wide Stairway. The open deck space is a promenade for Second Class Passengers.

At the aftermost end enclosed in a deckhouse are the isolation hospitals, etc., with a deck house above containing mortuary, embalming room : a wheelhouse is aft of this with a docking bridge on top.

On the Shelter Deck Amidships there is a large Entrance Hall, 43 First Class and 22 Second Class Staterooms interchangeable to First Class, the First Class Rooms are similar to those on Bridge Deck, many of them being of the Bibby type. Several of these staterooms have self-contained spray and W.C.

The Second Class rooms are fitted up as for First Class so that they may be used for First Class Passengers as occasion demands. The walls are all panelled in hardwood, passegeways are also panelled in hardwood. The first class rooms are arranged with single, two and three berths and the second class rooms with two or four berths. On the port side are the Engineers' Quarters adjacent to engine room entrance also accommodation for European head cooks, etc. At the forward end is the capstan engine space, Asiatic steerage airing space, Asiatic steerage hospital and dispensary, printing office, carpenter's shops, Asiatic petty officers and Asiatic steerage lavatories.

On this deck aft has been arranged a most attractive Suite of Third Class Public Rooms which are above the ordinary for this class, the Lounge being panelled in figured oak, the Smoking Room in Sycamore and the Entrance and Stairway in light oak : there is also open deck space for a Promenade. Two emergency dynamos, panic battery room and motor room for three capstans are arranged in steel house aft.

The Upper Deck is largely taken up by the Cuisine Department. True to their well-established reputation as caterers, the Canadian Pacific have left nothing undone to make the Kitchen and Service arrangements as thoroughly modern and complete as humanly possible. All cooking in the huge, spotless kitchens is done by electricity, and as far as practicable by mechanized appliances. Improvements in the storage and handling of food have been introduced, to such an extent that the Beer and Mineral Room and the Wine Room have been insulated and specially provided with a cool air current to enure a steady, dry temperature.

The First Class Dining Saloon on Upper Deck, one of the handsomest rooms afloat, has a seating capacity of 274 persons at one sitting, or, with the two adjoining Private Dining Saloons which open into the Main Saloon, of 294 persons. It is approached through the Foyer, decorated in the Louis XIV period and supported by marble columns with bronze enrichments. The carved balustrades of the Main Staircase terminate in the Foyer in illuminated alabaster ornaments.

Teak framed glass doors lead into the Dining Saloon, a beautiful Cipollino marble creation in grey-green-blue relieved with gilded bronze mountings. A lofty effect is obtained by means of a large open well, with a running gallery to port and starboard. Prominent is the Musicians' Balcony, in elaborate gilded bronze facing a large engraved mirror. Dark, carved mahogany furniture gives a note of warmth to this huge room, whose sidelights are screened by sliding windows and provided with carved teak shutters. A handsome Stairway and two Passenger Elevators are arranged at the fore end giving access to the various decks.

The Second and Third Class Dining Saloons also on Upper Deck are the full width of ship, panelled in Sycamore and oak: accommodation is provided for 128 persons and 52 persons respectively at one sitting, the tables being arranged for parties of two, four and six.

At the forward end of the Upper Deck there is accommodation for about 30 permanent Asiatic Steerage and 56 Chinese Seamen. There are also the Mail, Specie, Parcel and First Class Baggage Rooms, a large Kitchen for the Asiatic Crew, and a special Kitchen for Japanese. Forward of amidships is the European hospital and lavatory accommodation for crew, etc.

At the after end there are 24 Second Class Staterooms, the interiors and passageways being panelled in hardwood. The rooms are fitted out for two and four passengers, rooms for Asiatic Stewards are arranged at the stern.

On the Main Deck Amidships is the superb green and black marble Swimming Bath 30 feet long by 20 feet wide with a maximum depth of 7 feet 6 inches which is fitted out in generous lines with a refreshment pavilion, a spectators' balcony, dressing boxes, an electric bath—even with such luxuries as underwater lighting effects and can be reached direct by Passenger Elevator from the Gymnasium.

Accommodation is arranged for 100 Third Class Passengers in portable cabins aft and 368 Asiatic Steerage Passengers in portable open berthing forward which spaces can be used for carrying cargo. The Asiatic Steerage Dining Space is aft, abaft is the Kitchen, Pantry, etc., for the steerage, a working passage 6 feet wide entends fore and aft, accommodation is provided amidships for the Asiatic Crew. Dry store rooms are arranged under kitchen for ship's stores also butcher's and baker's shops, aft of the store rooms are four large spaces for the carriage of silk.

On the Lower Deck accommodation is arranged for 114 Asiatic Steerage Passengers in portable open berthing forward which space can be used for carrying Cargo, aft of this is another large space for the carriage of Silk.

On the aft side of engine room bulkhead are situated the Insulated Ship's Provision Chambers also the Insulated Cargo Chambers. A large Electric Elevator is arranged to enable the stores to be taken direct up to kitchen. Baggage Rooms and Cargo Spaces are aft also the Steering Gear Compartment.

The Orlop Deck is arranged for Cargo except one compartment which has a flush steel deck for the Stowage of Automobiles.

There are twenty-one sliding watertight bulkhead doors fitted, all operated by the Brunton Hydraulic System. This system permits of all the doors being closed simultaneously from the Bridge by the officer in charge, or being closed separately at the doors from either side of the bulkheads.

Before the doors close a bell at each door gives warning.

The power for this system is derived from two " Weir" pumps situated in the forward boiler room.

It is possible to open a door locally by means of the handle on the local control valve, but when the handle is released the door again closes.

An indicator is fitted on the Bridge which indicates by means of small electric bulbs whether the doors are " open" or " closed."

In addition to the hydraulic control, all doors are fitted with hand gear which permits of them being worked locally and from above the bulkhead deck.

There are 26 Special Board of Trade Lifeboats on board including two Motor Boats which are sufficient to accommodate the full complement of passengers and crew carried on the vessel. All the boats are stowed on Boat Deck under Welin-Maclachlan Patent Gravity Davits, with the Winches overhead, giving a clear fore and aft promenade on Boat Deck.

A considerable amount of the 10,200 odd tons deadweight in the *Empress of Japan* is allowed for Cargo although the vessel is intended more for the Passenger Trade. The Capacity of the permanent Cargo Holds and 'Tween Decks is 304,000 cubic feet which includes 59,000 cubic feet for Silk Rooms and 33,000 cubic feet for Insulated Cargo. This Capacity can be increased to 380,000

cubic feet when the number of Asiatic Steerage Passengers is reduced by about 480. The arrangements for loading and discharging Cargo are very efficient, Derricks being fitted on the fore and main masts also on posts at after end of Boat Deck, forward on Promenade and aft end of Bridge Deck. The Derricks numbering 23 are so arranged that Cargo can be discharged from the six hatches, over both sides of the Vessel simultaneously, and are worked by powerful Electric Winches.

One of the Derricks on after side of Fore Mast is arranged for dealing with heavy loads up to a weight of 20 tons.

There are six Holds and 'Tween Deck Spaces for Cargo arranged with widely spaced pillars to facilitate stowage and in the main 'tween decks cargo doors are arranged through ship's sides.

The spaces for carriage of Silk are on the Main and Lower Decks specially fitted up for such valuable Cargo.

The Insulated Cargo Chambers are on the Lower Deck Aft and are sub-divided for vegetables, fish, poultry, eggs, and meat, which are cooled by brine grids and air ducts, the chamber for fruit is cooled by air ducts only.

Large Insulated Chambers for Ship's Provisions are arranged on the Lower Deck forward of cargo chambers. The chambers for meat, poultry, fish, butter and eggs, cheese and ice are cooled by brine grids, fruit and flowers, wine, beer and minerals and vegetables cooled by air ducts.

The Refrigerating Machinery which is placed in the shaft tunnel comprises two separate sets of refrigerating machinery on the Co_2 Compression System working with brine circulation, and driven through a flexible coupling by direct-coupled electric motors. The evaporators, brine return tank, distributing boxes, etc., are situated in an insulated chamber aft of the refrigerating machinery, air-cooling batteries with fans and electric motors are placed over. There are also two large ice-making tanks in provision chambers. Cool cupboards are provided in bars, pantries, etc., worked off Methyl Chloride Plants.

Every provision has been made to bring the Navigating Officer into touch with any event which may arise in the course of navigating the ship. The Navigating Bridge with large wheel house and chart room is placed above captain's accommodation. A screen shelter with large windows is fitted at each side of bridge. On the Bridge are placed the telegraphs to the engine room, steering, docking, anchor and look-out positions, while Graham's multiphones are installed from bridge to docking bridge, crow's nest, look-out at bow and boat stations. Graham's loud sounding telephones from bridge to W/T. office, gyro compass room, chief engineer's room, steering compartment, and docking wheelhouse aft.

Instruments are installed in the chart room for "Echo" Sounding, Submerged Log Apparatus and Fire Alarms also Master Electric Clock for controlling the Electric Clocks throughout the Vessel.

At each side of Bridge is a semaphore and Morse lamp for signalling purposes.

A Docking Bridge with wheel house below is arranged aft.

The Steering Gear is of the electro-hydraulic type by Messrs. Brown Bros. & Co., Ltd., Edinburgh, and is controlled from Navigating Bridge by telemotors and from the wheel house under Docking Bridge by mechanical means. The telemotor cylinders are placed near the steering gear and connected by levers.

The Vessel is electrically lit throughout on the most modern lines and liberal scale in addition to the maximum of natural lighting.

In addition to the natural ventilating system, an elaborate system of mechanical supply of cold and heated air together with a mechanical exhaust system by the Thermotank Company using their latest improved patent Punkah and Revolving Punkah Louvres is installed throughout the Vessel to suit the varying climes she will trade in.

Description of Propelling Machinery*

The machinery of the *Empress of Japan* is one of the most efficient installations which has been produced by modern science. The design is the logical outcome of the ideas initiated by Mr. Johnson, the Owners' Chief Superintendent Engineer and which were embodied first in the *Empress of Australia* when that vessel was fitted with new machinery at Fairfield and which demonstrated that a fuel consumption of 0.71 lbs of oil fuel per S.H.P. was possible, even with cylindrical boilers working under moderate pressure and superheat. Subsequently Mr. Johnson developed the high pressure and high superheat geared turbine in conjunction with watertube boilers in the "Duchess" Class of steamers for the same Owners, thus bringing the consumption down to 0.63 lbs. and the latest development embodied in the *Empress of Japan* has effected a further reduction, which reflects the greatest credit on all concerned in the conception, design and construction of this vessel.

The machinery is capable of developing 30,000 S.H.P. continuously at sea in order to maintain a normal speed of 21 knots with one of the six main boilers in reserve, and if desired, an overload power of 33,000 S.H.P. can be maintained for long periods should an increase in speed be necessary at any time.

Under these conditions the machinery is very easily rated, and the power stated above contains a very ample margin so as to ensure that this speed will be maintained under all average weather conditions.

The installation generally consists of a twin screw set of Parsons' single reduction geared turbines, for which high pressure superheated steam is supplied by six Yarrow type watertube boilers burning oil fuel under forced draught with preheated air and open stokeholds.

The turbo feed pumps and turbo generators are driven by high pressure steam, but otherwise the majority of the auxiliaries are electrically-driven, the current being supplied by a combination of Diesel-driven and turbo generators.

The Engine Room is divided into two compartments with the Diesel generators and feed heaters in the Forward Room and the propelling machinery with its auxiliaries and the turbo generators in the Aft Room.

Low pressure steam for ship's heating, salt and fresh water calorifiers, galley purposes, and heating of fuel tanks, is supplied by either of two cylindrical boilers at 200 lbs. pressure, and steam from these boilers is admitted to the main turbines as necessary to make up the feed water loss in the water-tube boiler system. It is now recognized that watertube boilers are perfectly satisfactory if fed with pure distilled water, and by using steam from the auxiliary boiler to replace lost feed water, this object is attained although the feed make-up for the cylindrical boiler may be the usual fresh water from a town supply, or it may be from salt water distilled by the evaporators.

The chief features of this system are—an easy means of generating distilled water in bulk for the filling of boilers after cleaning; the readiness with which reserve tanks can be replenished while under way; the ability to maintain a constant amount of water in the system, thereby avoiding the necessity of intermittent replenishment of feed water losses; the definite segregation of the low pressure exhaust steam system with possible impurities from the high pressure system, the safety of which depends upon the exclusion of oil or scale-forming matter.

There is no doubt that the successful and safe functioning of high pressure watertube boilers and their superheaters depends upon extreme cleanliness more than any other factor. In the event of the fresh water reserve supplies being depleted, salt water is distilled in the evaporator by the use of low pressure steam, and the condensed vapor fed into the auxiliary boiler, so that in no circumstances is any raw feed likely to have direct entrance to the high pressure system. The essential conditions of facility and safety of operation are therefore secured.

If steam for hotel purposes is generated in a high pressure boiler it has to be reduced in pressure and desuperheated before it can be made available for domestic purposes.

The main propelling machinery consists of two sets of Parsons type turbines constructed by Fairfield and arranged to drive the propeller shafts through single reduction gearing. Each set comprises one high pressure; one intermediate pressure; and one low pressure turbine working in series, each turbine driving a separate pinion which engages with the main gear wheel. For Astern running a high pressure unit is incorporated in the intermediate Ahead casing and a low pressure unit in the low pressure Ahead casing.

When developing the normal service H.P. of 30,000, the propeller revolutions are 120 per minute; the corresponding revolutions of all the turbines being 1,490; and the ratio of reduction about 12½ to 1. The Astern turbines are capable of developing 65 per cent. of the Ahead service power.

*The Machinery Drawings of the *Empress of Japan* illustrating this article are reproduced from *The Marine Engineer and Motor Ship Builder*.

The high pressure Ahead turbine is of the impulse reaction type having a two-row velocity wheel with blades of stainless iron and the reaction portion is fitted with end-tightened blades of Monel metal. Nozzle control valves are fitted to enable a very gradual increase of power to be obtained and at the same time maintaining the pressure in the control chest as high as possible. Particular attention is paid to the lagging of all hot surfaces, and the thickness of plastic non-conducting material and mattresses for the H.P. turbine is about six inches, in addition to well arranged air spaces. It is essential for the well being of the engineers, as well as from the point of view of efficiency that as little heat as possible should escape from hot surfaces into the atmosphere of the Engine and Boiler Rooms. This has been most successfully accomplished.

The intermediate pressure turbine is of the reaction type throughout with the blading of the earlier stages of the end-tightened type and the later stages of the ordinary type, the material of the blades being phosphor bronze throughout. The L.P. Ahead turbine is of the reaction type with phosphor bronze blades.

The H.P. Astern turbine consists of a three-row impulse wheel and the L.P. Astern turbine of a two-row impulse wheel followed by reaction stages in which the blading is of stainless iron.

Owing to the high temperature of the incoming steam, the casings for all the turbines are of cast steel with the exception of the low pressure Ahead turbine which is of cast iron.

In order to eliminate vibration, all the rotors have been dynamically balanced (and during the Trials, including those in the Shop at overspeed revolutions, no trace of vibration was experienced).

The low pressure Ahead turbines are of the double-flow balanced type and each of the other turbines is fitted with a dummy to reduce the end thrust due to difference in steam pressure, and Michell thrust bearings of the spherical seated type are fitted to each rotor to take up any remaining axial thrust.

In order to facilitate the lifting of the turbine covers, the receiver pipes have been arranged underneath the turbines and connected to the lower halves in each case. Emergency connections have been fitted so that an H.P. or an M.P. turbine can be cut out if this should be found necessary at any time.

The turbines are supported at the Forward end by massive cast iron stools in a similar manner to the arrangement of the turbines adopted in the first instance in the *Empress of Australia* and subsequently in the *Empress of Canada*. The Aft ends of the turbines are as usual supported from the gear case.

The main gearing is of the usual double helical single reduction type, having a wheel of 162-in. diameter with a width of 59-in. The pinions are all 13-in. diameter and connected to the respective rotors by flexible couplings of the claw type. The teeth of the gearing are $\frac{7}{12}$-in. pitch and the helical angle about 30°. The gear case is of massive cast iron, the lower portion being extended as a flat base to about 2-ft. 6-in. above the tank top. The seating for the gear case and for the cast iron stools supporting the turbines are of plate and angle construction incorporated with the structure of the vessel and being of large area uniform in height and relatively low, are of great strength and should be free from the troubles often experienced with high built up seats, the riveted joints of which are liable to cause trouble with the straining of the Ship in a seaway.

The condensers are hung underneath the L.P. turbines and are of the Weir regenerative type with a large reservoir at the bottom for storing the water required in connection with the successful operation of the closed feed system. Each condenser has 16,000 square feet of surface, the tubes being $\frac{3}{4}$-in. diameter by 13-ft. 6-in. long and made of cupro nickel which has been proved to be so satisfactory in preventing condenser trouble.

To ensure that the feed water for the high pressure watertube boilers is absolutely pure and free from contamination by salt is of primary importance and provision has been made for frequent tests of the steam side of the condensers. With this end in view the water doors of the condenser have been very carefully designed to facilitate a quick examination of the tubes, and large hinged doors have been fitted in each end, jointed with a rubber ring recessed into the casing and secured by swivel bolts and dogs. The time taken to release the dogs and open the doors for the examination of practically the whole of the tubes is only a few minutes. Two large storage tanks for distilled water are fitted in the wings of the engine room from which the condensers may be filled by gravity when testing the condensers.

The thrust of the propeller is transmitted to the vessel by Michell thrust bearings fitted to the main lines of shafting immediately aft of the gearing, and the tunnel shafting is supported by bearings of the Michell journal type, the width of which is only about one-third that of a plain journal.

The propellers are of solid bronze cast by Messrs. J. Stone and Company Limited and are 20 feet in diameter.

The boiler installation was constructed by Messrs. Fairfield and is a development of the type fitted in the "Duchess" Class vessels recently completed for the same Owners. It is of course of larger capacity and the working pressure and superheat are also higher. For the main propelling machinery, turbo-driven generators and the main feed pumps, steam is generated in six watertube boilers of the Yarrow type at a working pressure of 425 lbs. per square inch and superheated to 725°F. Four of the boilers are placed in the Aft Room and two in the Forward Room together with the two cylindrical boilers which supply steam for make-up feed, ship's heating, and other auxiliary purposes. Each of the main boilers has one steam drum; three water drums; and one superheater drum; each drum being forged solid without either circumferential or longitudinal seam or joint, thus avoiding any trouble which may occur with riveted joints. As will be seen from the illustration, the flow of the gases is through one side of the boiler, after which it passes through a large tubular air heater and thence to the funnel.

The air preheaters are of the tubular type and of very large surface, in order to abstract the maximum amount of heat from the waste gases and thus secure the maximum boiler efficiency. In making a comparison with the practice of ten years ago it is remarkable that the large boiler heating surface which was then considered essential to economy has now been considerably decreased, and the air preheating surface then comparatively insignificant, has been enlarged so that the air heating surface is now 30 per cent. more than the generating surface.

The air trunks from the preheaters have been arranged so as to enclose the boiler casings to a large extent, so that heat transmitted through the casings is caught by the air and returned to the furnace, and a careful arrangement of lagging outside the preheaters, hot air passages and boiler casings reduced radiation losses to a negligible quantity.

A special arrangement has been made for carrying the weight of these boilers, the main support being in the form of vertical columns at the fore and aft ends upholding the steam drum and the weight of the other drums is carried by the tubes. Very little weight therefore is imposed on the fore and aft casings.

The saturated steam is taken from the main drum through a Vortex separator, to one end of the superheater drum through an external pipe and it is directed by means of internal troughs and baffles through banks of the superheater tubes in series to the other end of the superheater drum. A high lift safety valve, together with the main boiler stop valve which is of the latest self-closing type, are fitted at the outlet end of the superheater drum.

The boilers are fitted with automatic feed regulators on both main and auxiliary feed pipe lines, and soot blowers are fitted at various stations in order to maintain the generator and superheater surfaces in clean and efficient condition.

In addition to the usual mountings a low water alarm of a very efficient type has been fitted to each boiler, which, when the water falls below a predetermined level, blows an alarm whistle and shuts off the oil fuel supply to that boiler.

The firing space, instead of being athwartship in the usual manner, is arranged fore and aft, and this arrangement is advisable by way of ensuring efficient control with the free observation from end to end of the boiler rooms. The space between the boilers is occupied by oil fuel units on the Wallsend-Howden system, and it is expected that a boiler efficiency of 87 per cent. will be comfortably obtained on service.

The auxiliary boilers for domestic and other auxiliary purposes are of the cylindrical return tube type, arranged to burn oil fuel with the Howden system of forced draught and are designed for a working pressure of 200 lbs. per square inch.

The supply of air to the main boilers is drawn from the Boiler Room by six motor-driven forced draught fans of Howden's make, one fan being fitted to each boiler.

In order to assist the draught under certain conditions there are also six induced draught fans fitted in the uptakes above the air heaters but these can be byepassed if not required.

For the auxiliary boilers one double inlet fan is fitted which can be connected to either of two motors, each with a separate starter in order to secure immunity from complete breakdown.

The main oil fuel installation consists of six units each comprising one pump and one heater with the necessary suction and discharge strainers. A duplex type unit is provided for the auxiliary boilers and a motor-driven lighting-up set is fitted with connections to each Boiler Room.

For transferring oil to the settling tanks and between the other fuel oil tanks, one motor and one steam-driven transfer pump are installed.

The feed pumps for the auxiliary boilers, together with an auxiliary condenser and circulating pump are installed in the Forward Boiler Room, and in addition two evaporators and two distillers, all adjacent to the cylindrical boilers so that this auxiliary plant is very compact and convenient.

The steam from each pair of watertube boilers is collected and led to the bulkhead valves in a separate pipe, there being three main leads, and the bulkhead valves are isolated by two cross-connection valves so that any pair of boilers can be shut off. The Ahead and Astern manoeuvring valves are combined in one chest together with an additional shut-off valve for the Astern to prevent leakage at sea. Before entering the turbines, the steam passes through a wire grid strainer designed to reduce loss in pressure to a minimum. The expansion of the steam pipes, owing to the high temperature of the steam, is taken up by corrugated pipe bends and the arrangement is very simple and effective.

The feed water circuit for the main boilers is arranged on Messrs. Weir's closed feed system, with a view to keeping the water entering the boilers as free from air as possible. The condensate in the well at the bottom of the condensers is withdrawn by motor-driven centrifugal extraction pumps, of which there are four, each capable of dealing with half the total condensate, and it is discharged through drain coolers to the feed pumps. There are four feed pumps of the turbo-driven centrifugal type, two main and two auxiliary, using superheated steam from the main boilers. A large feed tank is placed at the Forward bulkhead as a reservoir and float operated supplementary and overflow valves are fitted to maintain a constant level in the condensers. The water, on leaving the feed pumps, passes first through filters and then through primary and secondary heaters in series to the boilers. The primary heaters are supplied with auxiliary exhaust from the feed pumps and steam bled from the intermediate pressure turbines, and the secondary heaters with steam bled from the high pressure turbines. The drain from the secondary heater together with feed regulator leak-off is led to the steam side of the primary heater, the drain from which yields up its heat to the feed water in the drain cooler so that there is practically no loss. The air ejectors have three steam jets in series and are supplied with steam from the auxiliary boilers and drain to the main condenser and feed tank, the additional water thus obtained going to make up for any loss which may occur in the main system. An electric salinometer is installed for testing the feed water for the presence of salt.

Water meters were fitted for measuring the water used by the turbines and for other propelling purposes during the Trials, and the results, in combination with the fuel measurements, showed that the anticipated efficiency of turbines and boilers had been amply realized.

There are four main circulating pumps of the vertical spindle centrifugal type driven by electric motors.

The forced lubrication systems of the Port and Starboard sets of machinery are separate and independent. The oil is drawn from a drain tank under each set of gearing through duplex strainers and discharged to duplex filters to the oil coolers and thence to the bearings and gearing. Separate valves are fitted to the bearings to regulate the flow of oil as required. There are three motor-driven Centrex pumps on each side of the vessel and under normal working conditions two pumps on each side are in use. Should the oil pressure fall below a predetermined amount or should the rotors move aft due to wear in the thrust bearings, the bulkhead valves are automatically closed. A governor is fitted to one turbine in each set which also operates the oil control of the bulkhead valves if the revolutions should become excessive.

For the various duties of bilge pumping ballast, sanitary, wash-deck and fire service, a battery of six motor-driven pumps of the Centrex type are installed, all of identical design and with interchangeable duties. Two smaller pumps of a similar type are provided for the fresh water service.

The electric generating plant supplied by Messrs. W. H. Allen Sons and Company Limited is of particular importance and interest. The main plant consists of four generators each having an output of 300 kw., placed in the Forward Engine Room, each generator being driven by a six-cylinder four-stroke cycle Diesel engine with air injection. This Diesel installation is complete with independent circulating pumps, oil purifiers for fuel and lubricating oil, motor-driven emergency and starting air compressor, fuel transfer pump and electrical oil fuel heater.

Two 600 kw. steam turbo generators are placed in the Aft Engine Room, driven by superheated steam from the main boilers.

Under normal circumstances at sea three of the four Diesel generators will be required and they will also be used in port on account of their greater economy thereby enabling a complete shut-down of the steam boilers. Owing to space occupied, first cost and weight, it is not economical to provide reserve generators of the Diesel type. The combination of these generators gives not only the advantage of two sources of supply but also by making use of the steam sets when manoeuvring with the main engines ensures a constant flow of steam through the superheaters and thus prevent overheating.

A vapor extractor is fitted in the motor room to prevent the atmosphere becoming foul with oil vapor.

Store Rooms are provided at the Aft end of the main Engine Room at the lower deck level and between the shafts in the tunnel, and a Workshop on the Starboard side, containing a Lathe; a Drilling Machine; and an Emery Wheel.

An Electrical Workshop is situated on the main deck where there are a small Lathe and Sensitive Drilling Machine.

As this vessel is primarily intended for the Pacific service through the tropics, particular attention has been paid to the ventilation of the machinery spaces and the arrangements have proved to be very efficient. In each Boiler Room four large trunks are led to the stokehold from cowls situated round the funnel on the top of the casing. This natural draught is assisted by two motor-driven fans on deck which discharge air through ducts leading into the natural draught trunks. The forced draught fans are placed low down in the stokehold and arranged at the wings and at the center so as to ensure a flow of air efficiently ventilating the whole of both Boiler Rooms. Two additional fans are fitted in each room for drawing hot air from the spaces underneath the main boilers and other pockets which would not be cleared in the ordinary way. A positive system of air supply is arranged in the Engine Room, the air entering through large openings at the Forward end of the Engine Room and aft from the tunnel and exhausting up the main hatch through the dummy funnel.

On the top of the casing above the generator room there are two large supply fans discharging through trunks to the generator room, the trunks splitting up into two, one half being led aft through the screen bulkhead into the lower part of the main engine room, and the remainder of the air, after ventilating the Diesel engine room, also passes through an opening in the bulkhead into the main engine room. Two fans, situated on the top deck discharge into trunks which can be used for natural or forced ventilation to the aft end of the engine room from the shaft tunnel. Two supply fans also fitted with trunks led to the wings of the engine room. The outlet from the main engine room is through the dummy funnel, the height of which induces a natural draught, and in order to assist this natural upcast, four exhaust fans are fitted in the main engine hatch drawing from the level of the upper deck and discharging to about the top of the dummy funnel.

For fire extinguishing a complete CO_2 system is fitted in both boiler rooms, consisting of high pressure bottles situated in a house on the boat deck with pipes led to a control cabinet on the main deck, accessible from the working passage. Should a fire occur in either boiler room, the pulling of a wire is all that is required to flood the boiler room with CO_2 gas. A few of the bottles are connected to a control placed in each stokehold with pipes led to a hose for dealing with small local outbreaks. A connection to the main CO_2 supply is also made from the fire extinguishing installation supplied for the cargo holds, and hand extinguishers are placed in suitable positions throughout the boiler, generator and engine rooms. In addition to the foregoing a system of steam fire extinguishing is installed underneath the fronts of the boilers with steam taken from the auxiliary boilers.

The efficient manipulation and control of an installation of machinery of this type is very far removed from the requirements of the more primitive methods employed for engines in ordinary

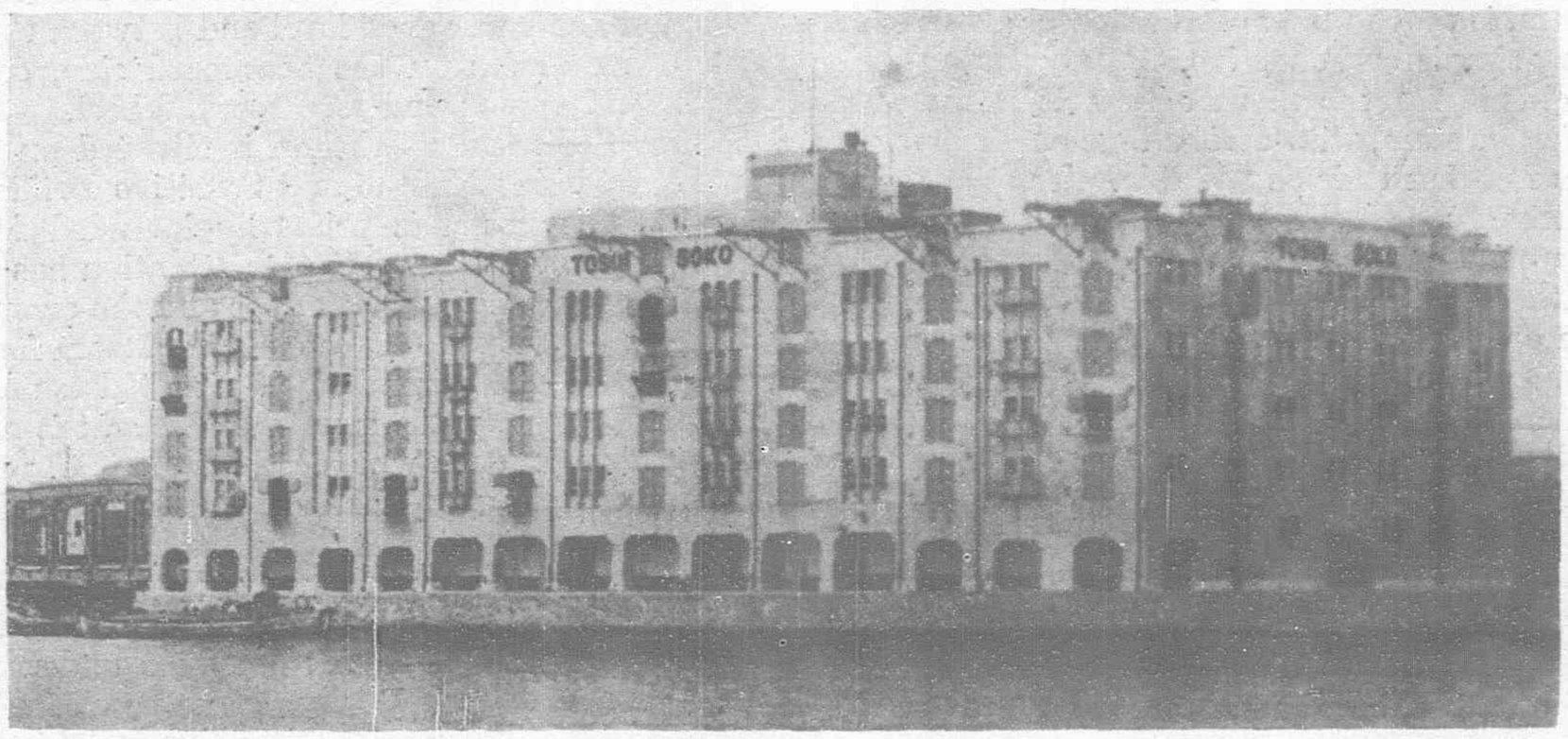
(Continued on page 460).

The Toshin Soko

The Mitsui Warehousing Activities; A Typical Example of the System of Business Co-operation and Co-ordination Responsible for Japan's Success in World Trade

In the July number of *The Far Eastern Review* appeared an article describing the shipping and shipbuilding activities of the great Japanese world-trading concern, the Mitsui Bussan Kaisha, a subsidiary of the Mitsui Gomei Kaisha, the holding company for all the enterprises of the House of Mitsui. In the same progressive spirit that the Mitsuis have attained a foremost place in the trading and shipping activities of Japan, they have taken the lead in creating a modern bonded warehouse system to meet the requirements of the rapidly growing trade of the country.

Modern warehouse construction providing security against earthquakes and fires and ensuring quick dispatch and handling of cargo, is keeping abreast of harbor and wharf improvements in all the ports of the Orient. This is particularly true of Japan, where the lessons of the Great Earthquake and periodic conflagrations have compelled a complete revolution in old style warehouse design. In all the larger cities, such as Tokyo, Yokohama, Nagoya, Osaka and Kobe, modern reinforced concrete buildings, equipped with the latest mechanical cargo handling devices, fire prevention and extinguishing apparatus and other safeguards for the storage of goods and their rapid handling, have superseded the older type of structure, erected originally for the storage of rice and other purely domestic commodities.

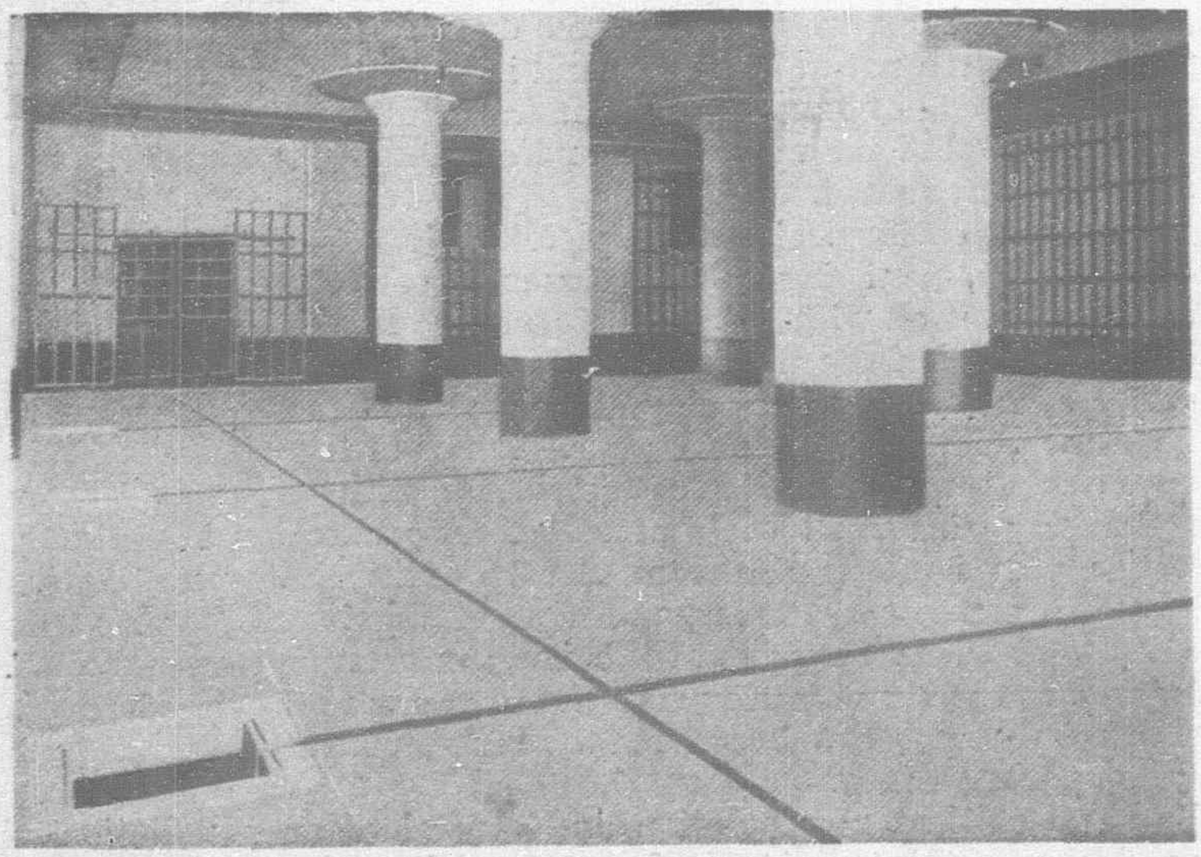


East View of the Toshin Soko, Tokyo Warehouse

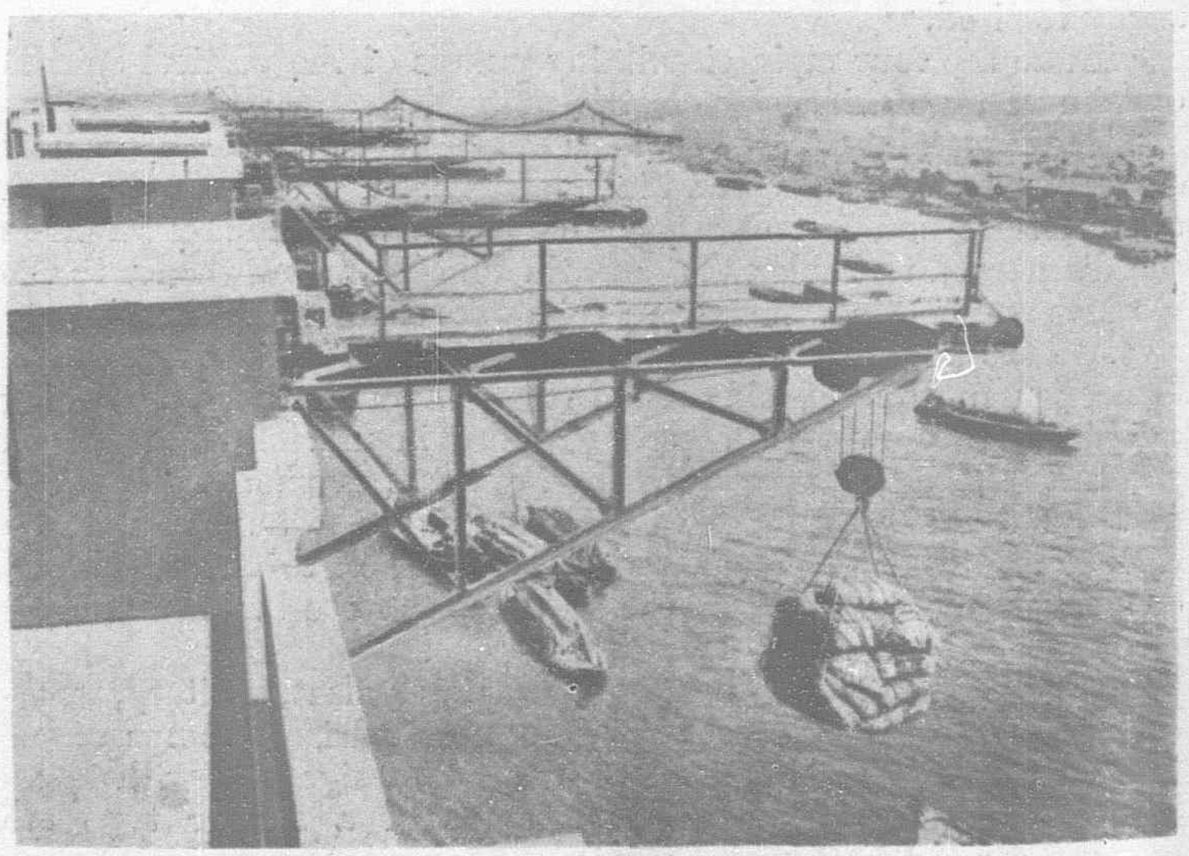
Although other great Japanese commercial organizations like the Mitsubishi, and the Sumitomo and the Kawanishi Warehouse Company have erected up-to-date earthquake and fireproof reinforced concrete warehouse structures, it is not unfair to these interests to state that the leadership in this line of business is held by the Toshin Soko, a Mitsui subsidiary, which handles over twenty per cent. of all the goods stored in the country.

The earthquake brought forcibly home to the Mitsuis the urgent necessity of replacing their old buildings with the most modern types of earthquake and fire proof structures and in compliance with a program laid down in 1925, have completed a series of warehouses in Tokyo, Yokohama, Osaka and Kobe, which stand as models of their kind in this part of the world. All these buildings, five in number, are of the same general massive design, varying only in the ground and floor areas. They are all equipped with the fire-prevention and extinguishing apparatus, electric passenger and freight elevators, hoists, spiral chutes, mechanical cargo-handling devices, mono-rails and hoists, railway sidings with outdoor travelling cranes and other appliances making for security and rapid dispatch. The warehouses in Yokohama and Kobe, the two principal silk ports of Japan, have been specially designed for the bonded storage of this highly valuable commodity. The rooms devoted to silk storage are floored and partitioned with wood, with special ventilating and heating equipment, and conditioning rooms adjoining for the preparation and sorting of the silk.

The completion of these splendid post-earthquake structures in the four principal ports of Japan, together with branches in Nagoya and Moji, enables the Toshin Soko to provide an efficient and co-ordinated service as warehousemen, forwarding, landing and shipping agents, stevedores and customs brokers, packers and expressmen, that cannot be duplicated in any other part of the world.



Storage Room

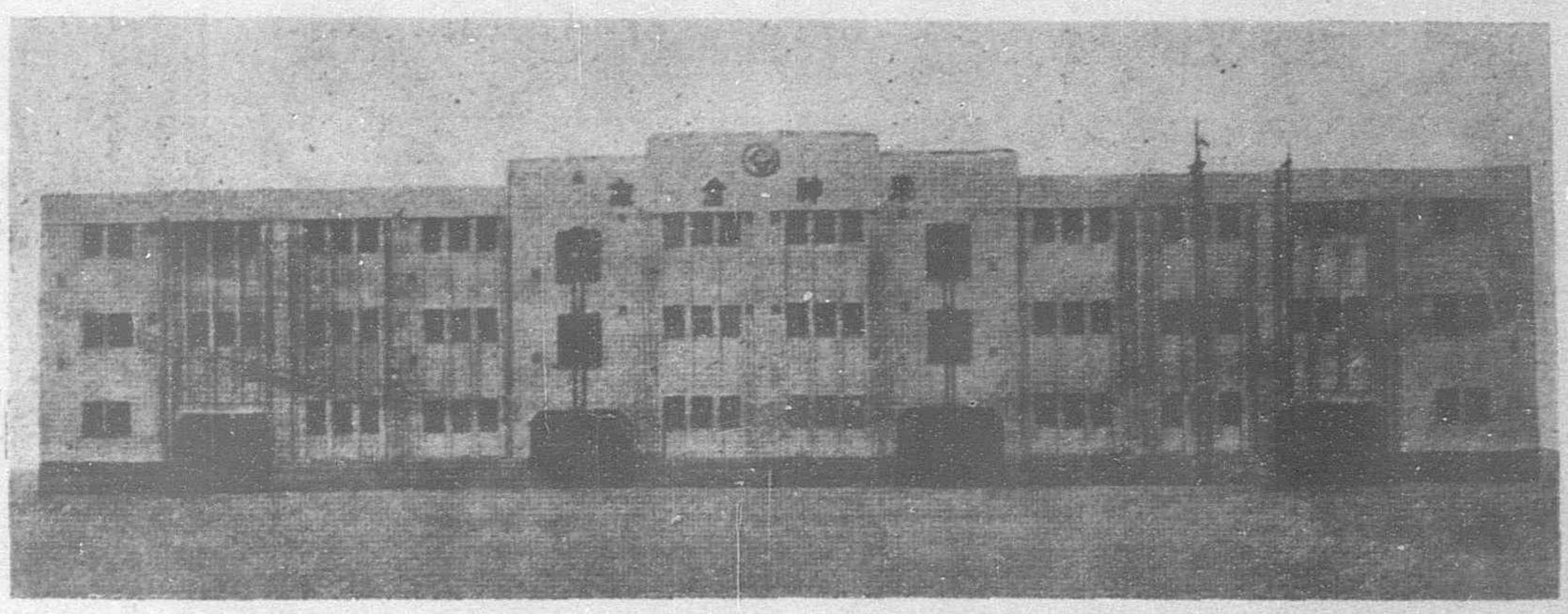


Mono-Rail Hoists

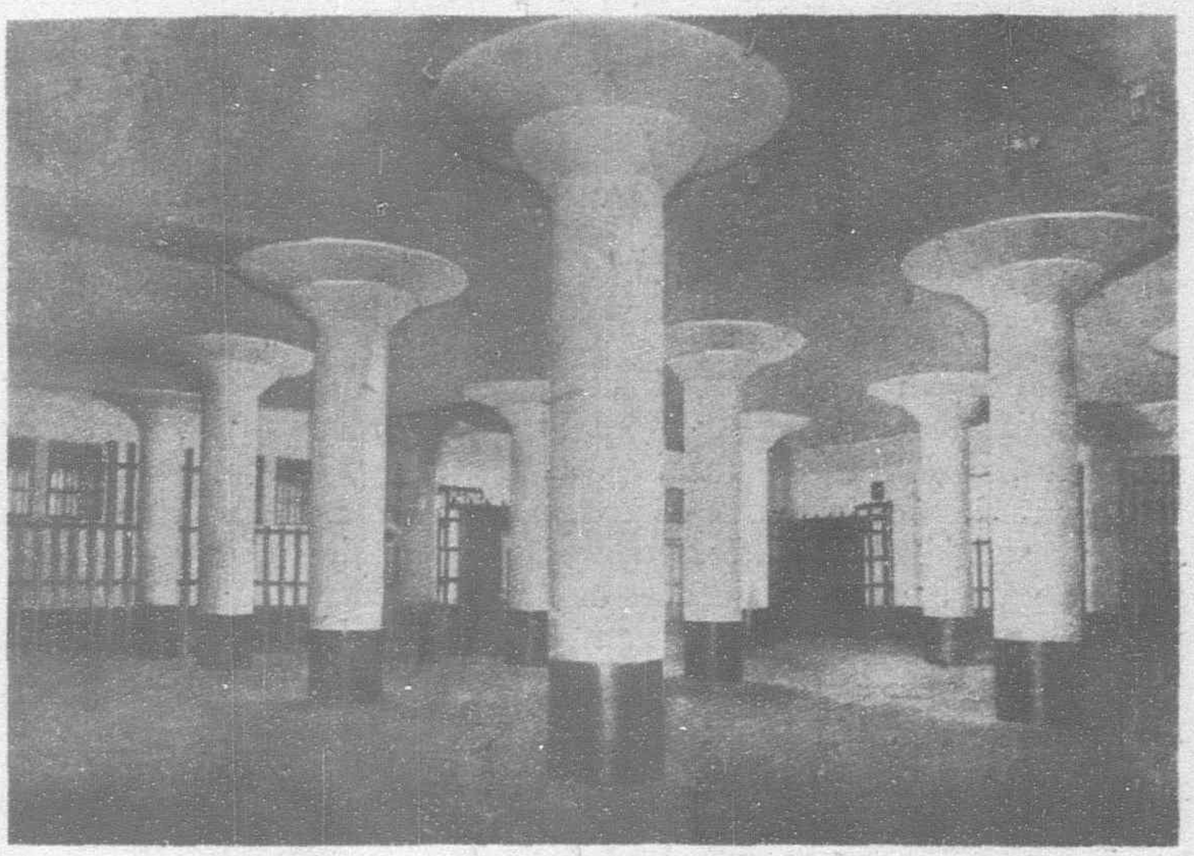
Toshin Soko, Tokyo Warehouse

This branch of the Mitsui activities is known as the Toshin Soko, Limited, a Yen 15,000,000 concern at whose head is Baron T. Mitsui, with Mr. K. Okumura and R. Kadono as Managing Directors and Messrs. K. Hayashi, and K. Fukui, Directors. The warehousing activities of the Mitsuis were originally conducted as a subsidiary of the Mitsui Bank, but when the Mitsuis reorganized their business system and constitution in October 1909, the warehousing was organized into an independent company with a capital of Yen 2,000,000, and with establishments in Tokyo, Kobe and Moji. In 1915, the Toshin Soko acquired the property and business of the Kobe Pier Co. Ltd., and in 1918, the Osaka Warehousing Co. Ltd., thus securing choice locations in these two great trading centers. The capital was increased from two million to five million yen to take care of this expansion and in 1923, it was further increased to fifteen million yen to carry out the new construction program.

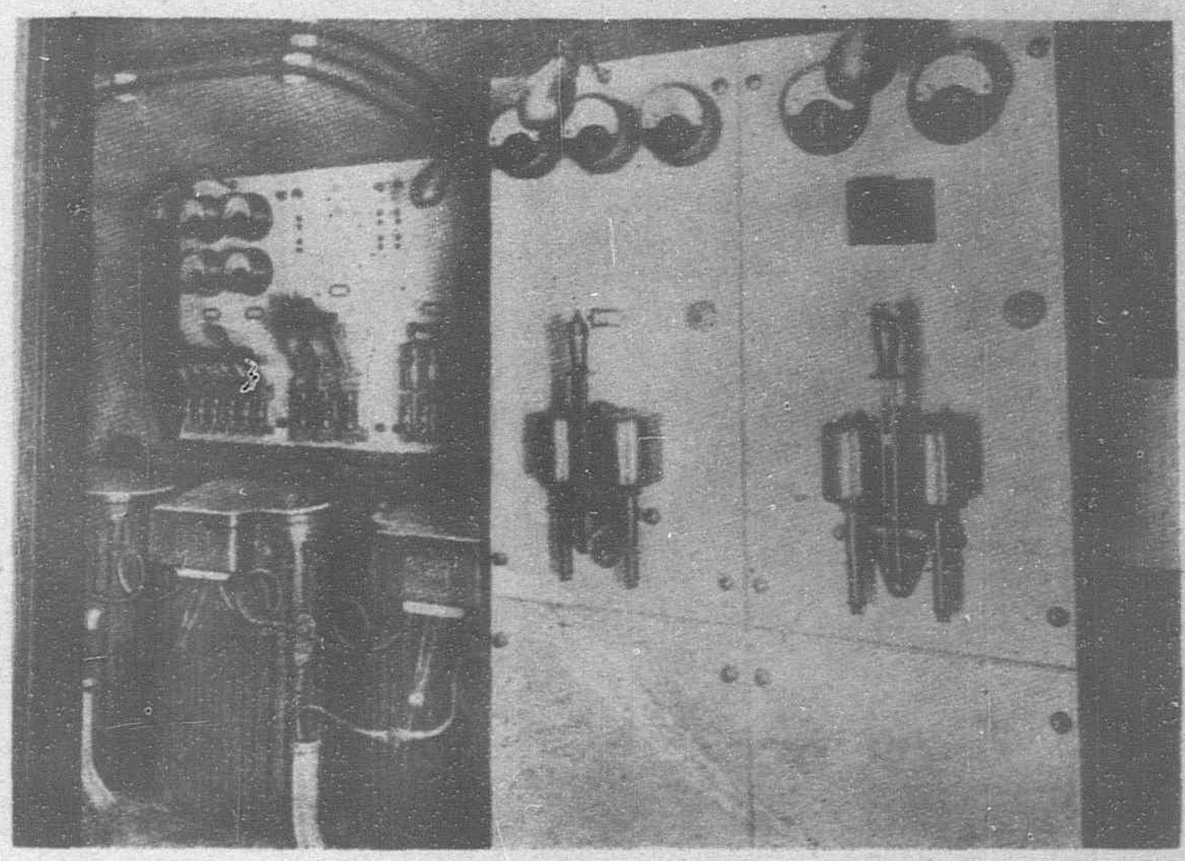
The reinforced concrete and brick warehouses of the company cover an area of over seventy acres, storing goods and merchandise to the value of about Y.100,000,000, equivalent to about one-fifth of the total storage balances in all Japanese warehouses. The following storage balances in the Company's warehouses and their share in the total storage balances in Japan indicates the position of the company in the warehouse business of the country;



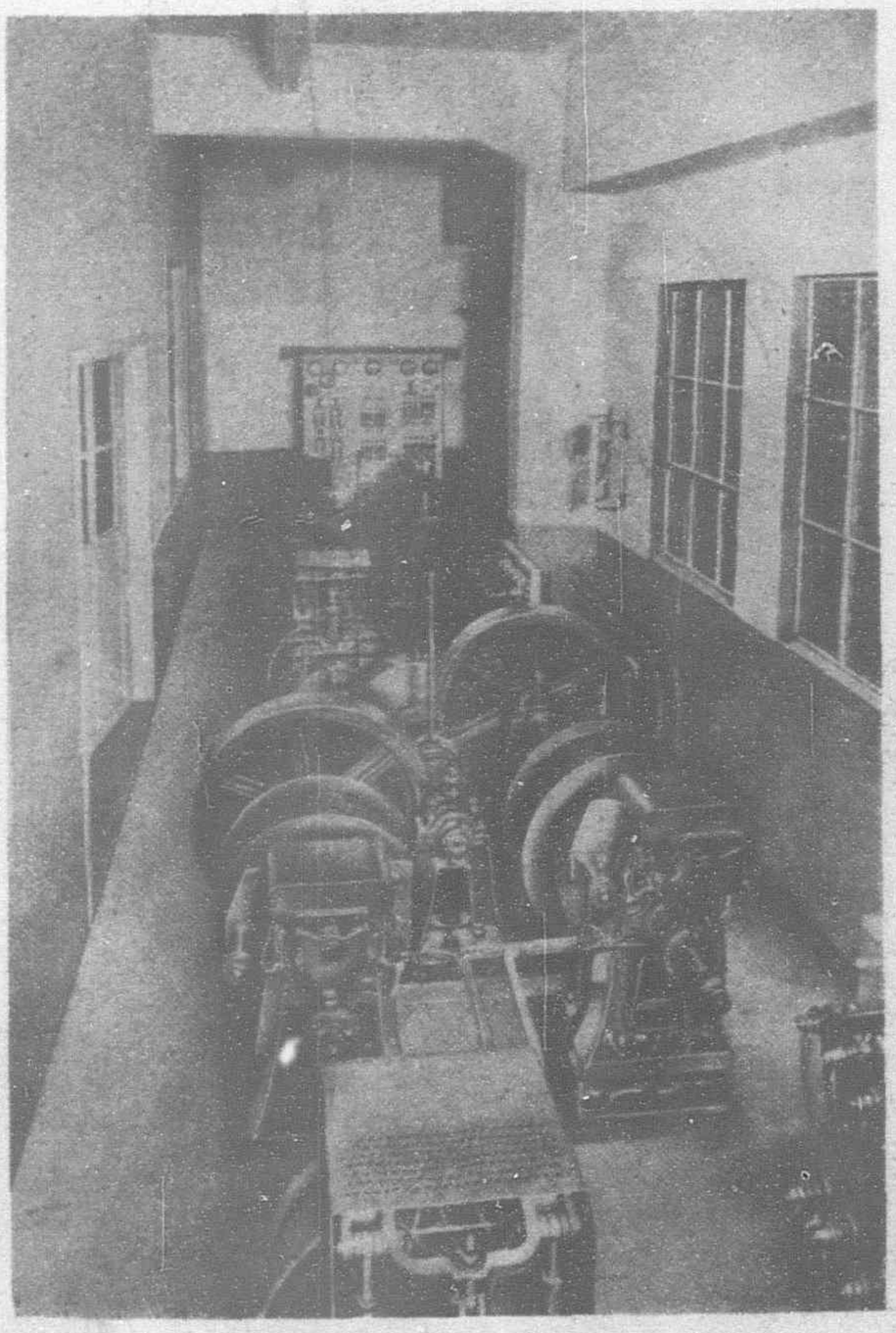
Front View, Yokohama Warehouse of the Toshin Soko



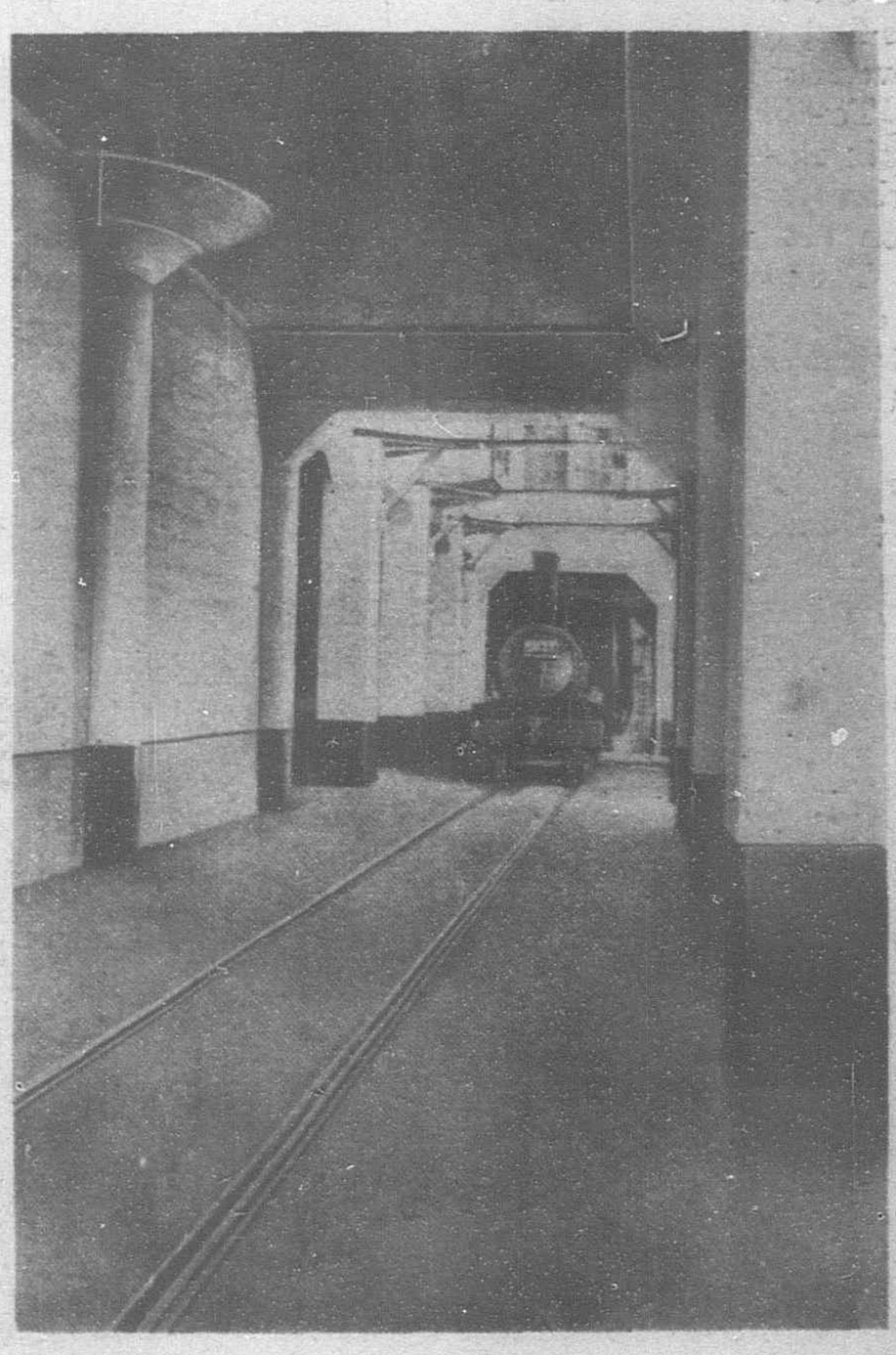
General Storage Room



Transformer Room

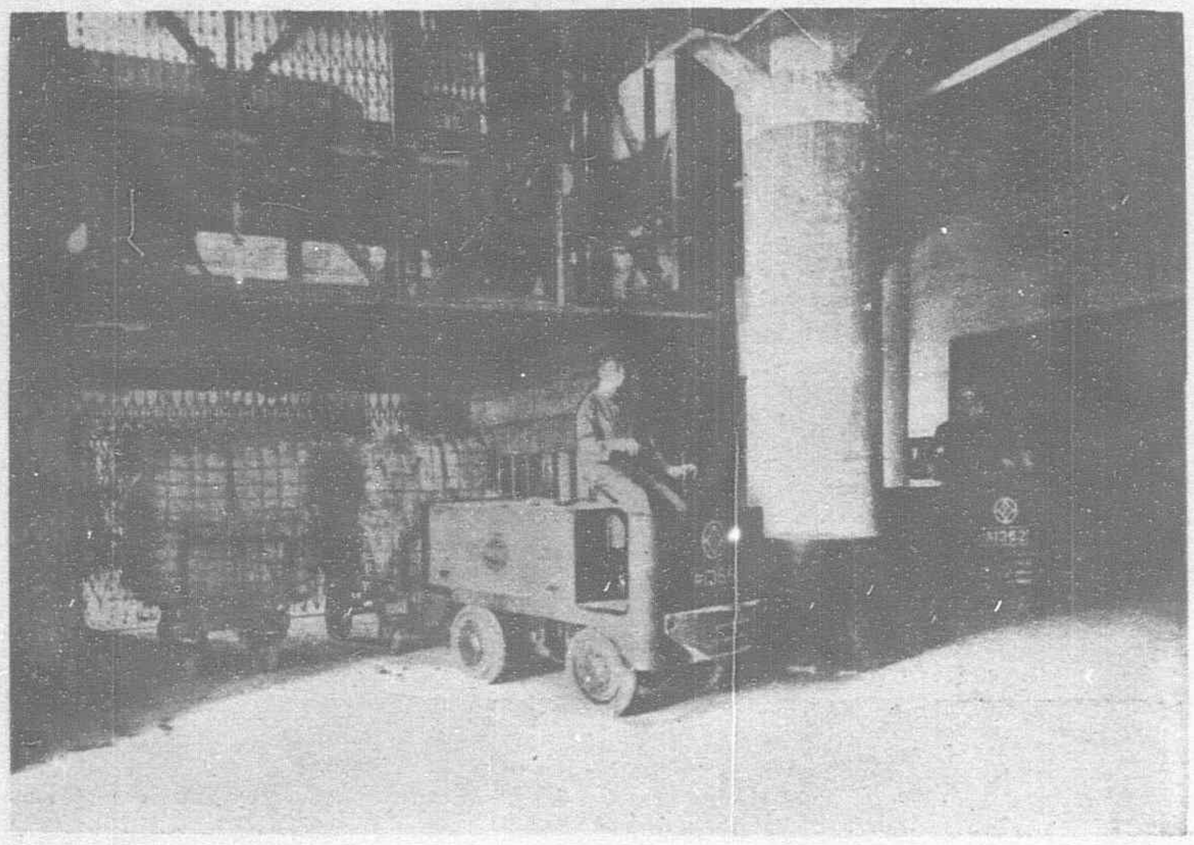


Hoisting Engine Room

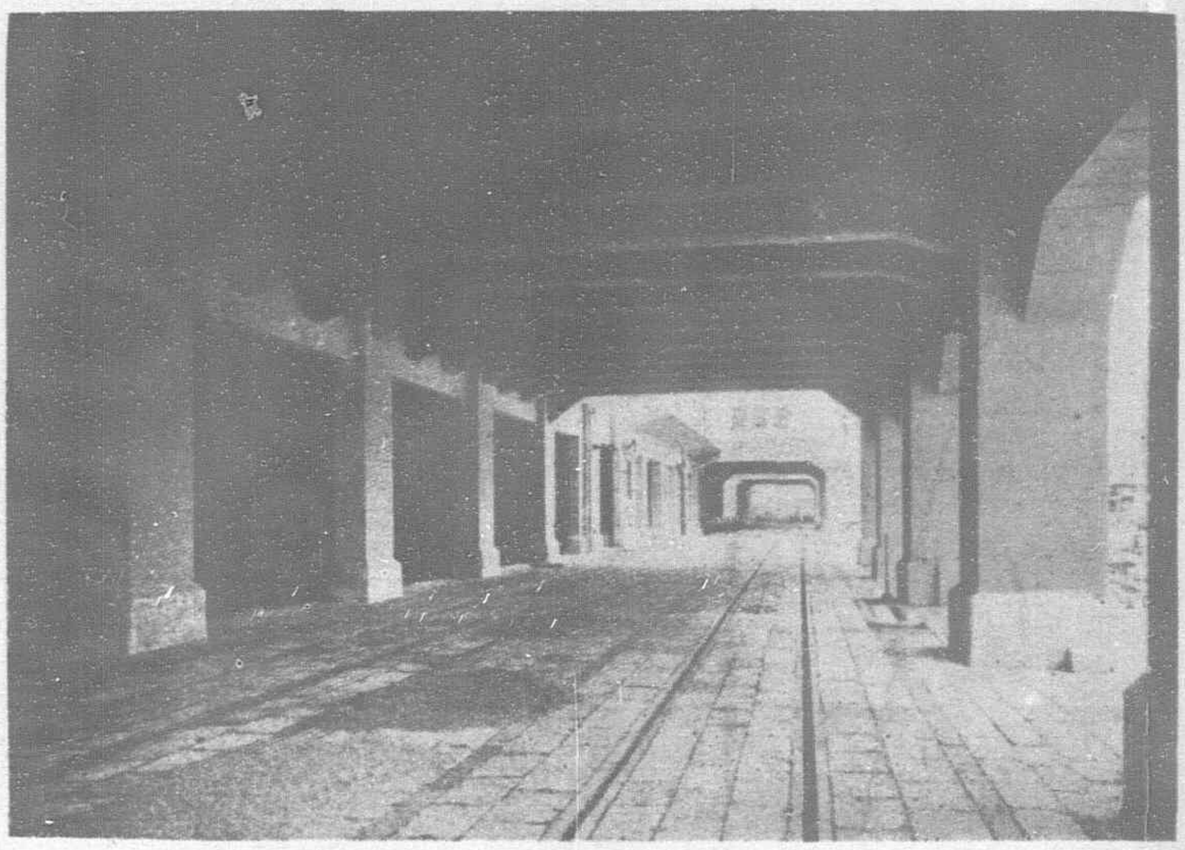


Railway Siding

TOSHIN SOKO'S WAREHOUSE AT KOBE



Elevators and Electric Trucks



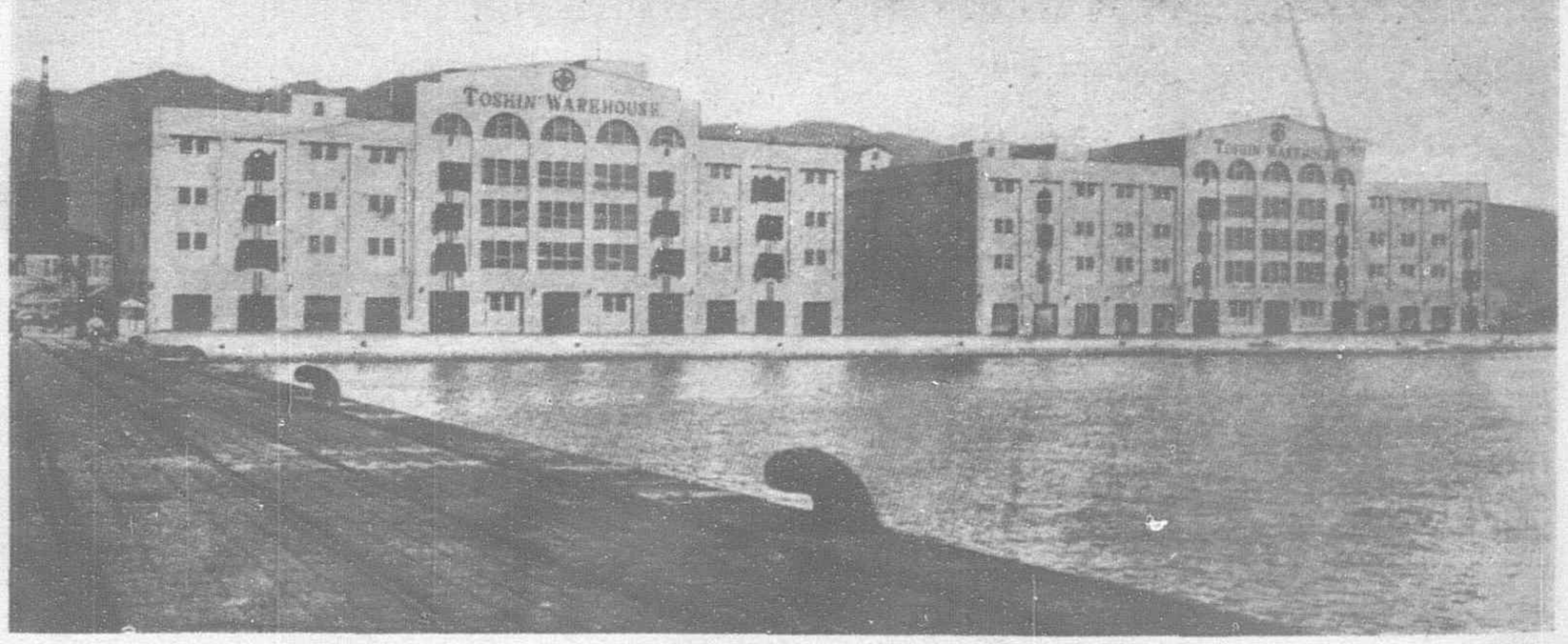
Loading Space, Showing Railway Sidings

	Dec. 31, 1928	June 30, 1928
Tokyo	Y.14,968,358	Y.21,631,504
Yokohama	15,208,971	10,256,559
Nagoya	3,430,859	4,741,216
Osaka	23,357,969	38,010,153
Kobe	20,474,972	23,589,193
Moji	5,786,884	8,027,577
Total (Company's)	83,228,013	106,256,202
Whole Country's Total	471,490,209	519,851,324
Percentage	17.7%	20.4%

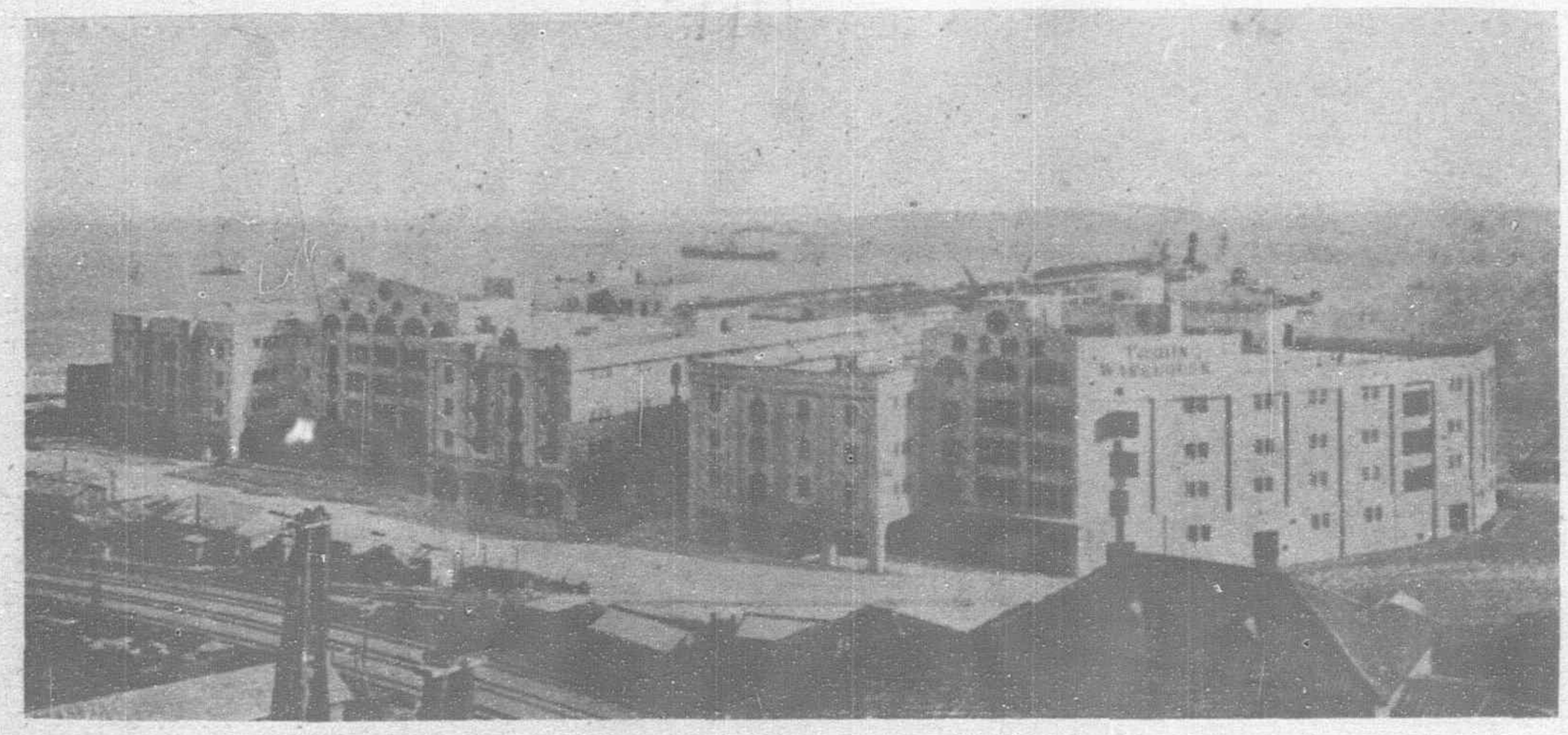
As will be seen from the above table, the company with its head office and warehouse in Tokyo, has five branches. The enterprise at Kobe and Osaka is of particular importance as in the early days of Kobe the warehousing at this port was confined to rice and other commodities for the home market. The Mitsuis were the first to build warehouses for the use of overseas trade at this port. In 1916-17 the Toshin Soko constructed long quaywalls in close proximity to the Government harbor works, and established direct connection between the railways and steamers. These quay-walls are of such size and depth of water that the largest ocean steamship can be moored alongside. In Osaka, the Company owns several acres with sheds of several thousand *tsubo* adjacent to the new harbor. A ferro-concrete warehouse was recently built at Sakurajima in close proximity to the harbor.

In addition to its warehouse business, the Toshin Soko has extended its activities to various allied enterprises. A subsidiary in Osaka, called the Kyoshin Gumi, Ltd., engages in packing, loading and transportation of goods in the Kwansai District, while another subsidiary, the Tsisho Unyu, Ltd., with a capital of two million yen, operates a number of small steamers for interport service between Kobe and Osaka and between Yokohama and Tokyo.

Here we have another example, of the complete co-operation and co-ordination of business, typified in Japan's cotton industry,



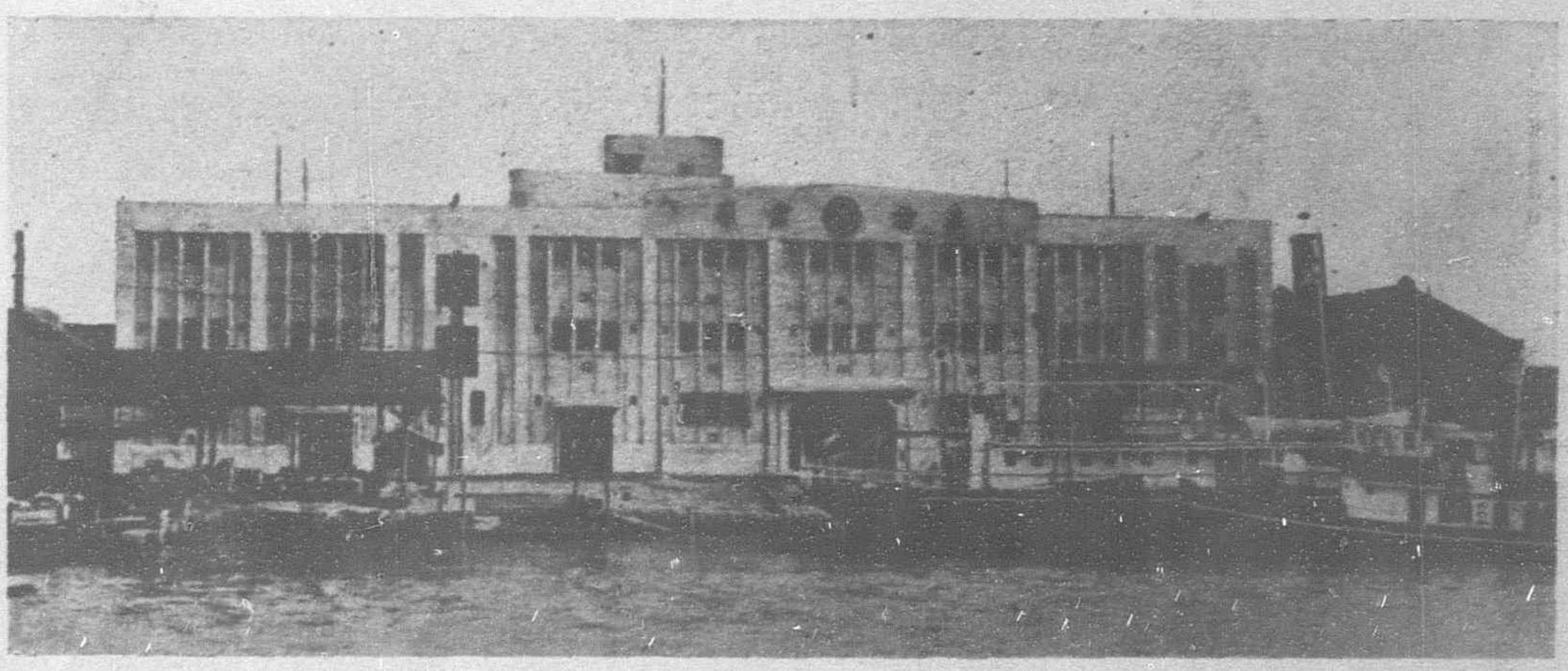
South View of the Kobe Warehouse of the Toshin Soko



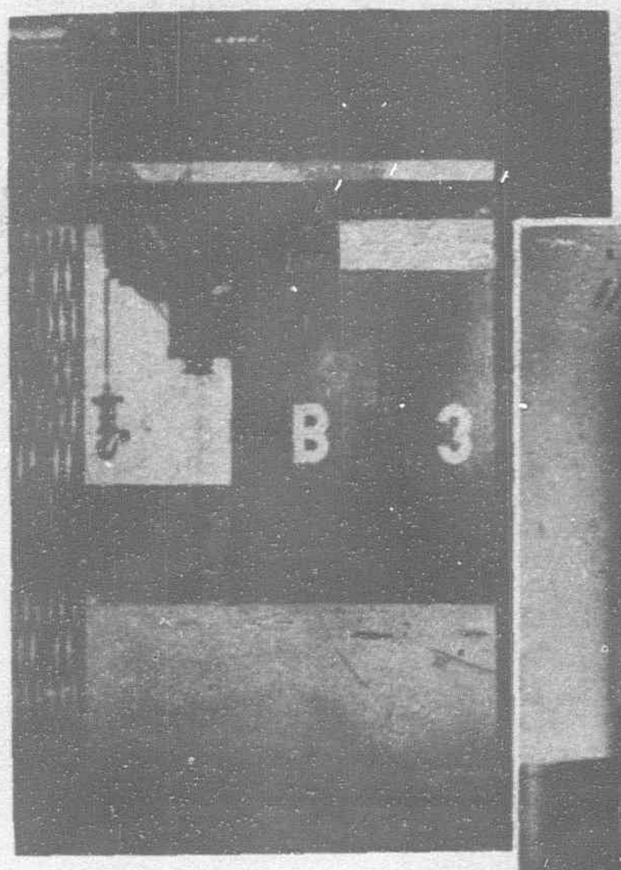
North View of the Kobe Warehouse of the Toshin Soko

enabling her to buy the raw material in the cotton producing centers of the world, transport it to Japan, manufacture it into yarns and piece-goods and export the finished products to the country of origin and undersell the native textile mills in their own market. This scientific organization in the cotton industry is the real secret of Japan's trading success and is possible only where control is vested in the central directorate like the Mitsui Gomei Kaisha. On a smaller scale, the Mitsui warehousing business constitutes another complete in organization of every activity entering ito the successful operation of the enterprise. The Toshin Soko receives the cargo at the vessel's side, whether from overseas or from the smaller Japanese ports, acts as stevedores, landing, shipping and forwarding agents,

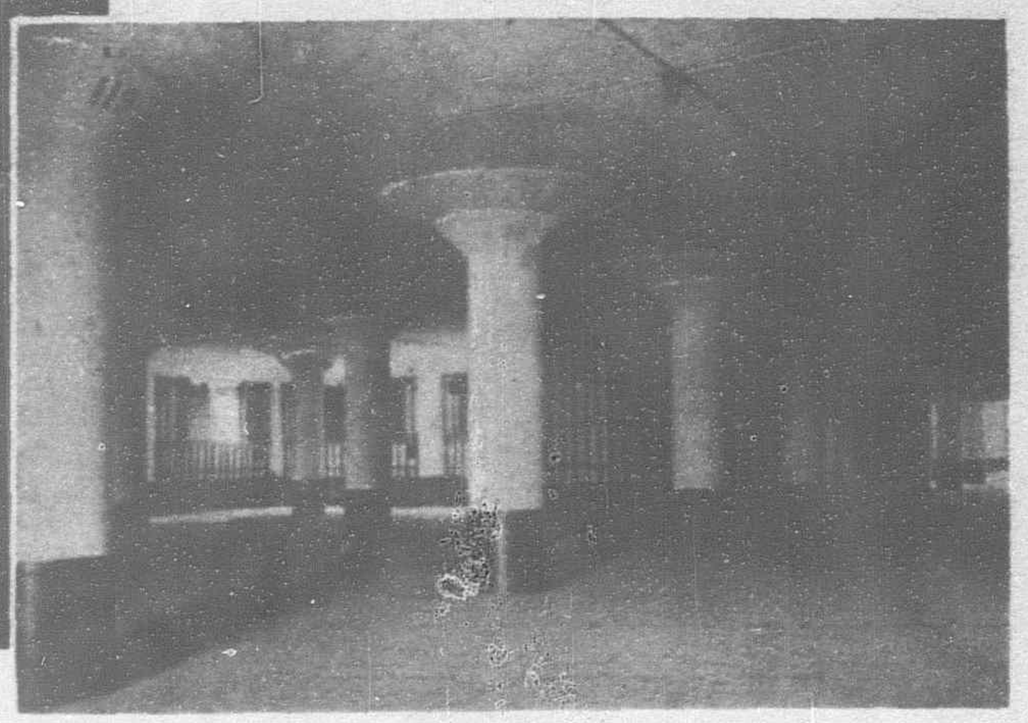
expressmen, customs brokers, packers, insurance, financing, collecting, and every other detail connected with the shipping, storing and handling of goods. It is difficult to beat a combination like this or to improve upon its service, for where one branch fails to make a profit, the loss is made up in some ramification of the vast Mitsui industrial enterprises.



Toshin Soko Warehouse at Tomijima-cho, Osaka



Elevator



Ground Floor

Toshin Soko Warehouse, Osaka

Tokyo Warehouse

The new warehouse at Tokyo covering an area of 27,380 sq. yds. is located on the bank of the Sumida River, in Hakozaki-cho, Nihonbashi Ward. Its construction was started in April, 1927, and completed in July of the following year. The warehouse occupies 4,088 sq. yds. with a total warehousing area of 21,556 sq. yds. The building is of reinforced concrete designed to resist earthquakes and fire. It is seven stories high 95 feet from the ground level to the roof. A transformer room is located on the first floor, all mains and feeder wires being laid in enclosed conduits. The structure is brilliantly lighted with 60, 100 and 150 c.p. lamps, while at convenient places are fitted plugs for operating electrically driven cargo-handling devices and hoists.

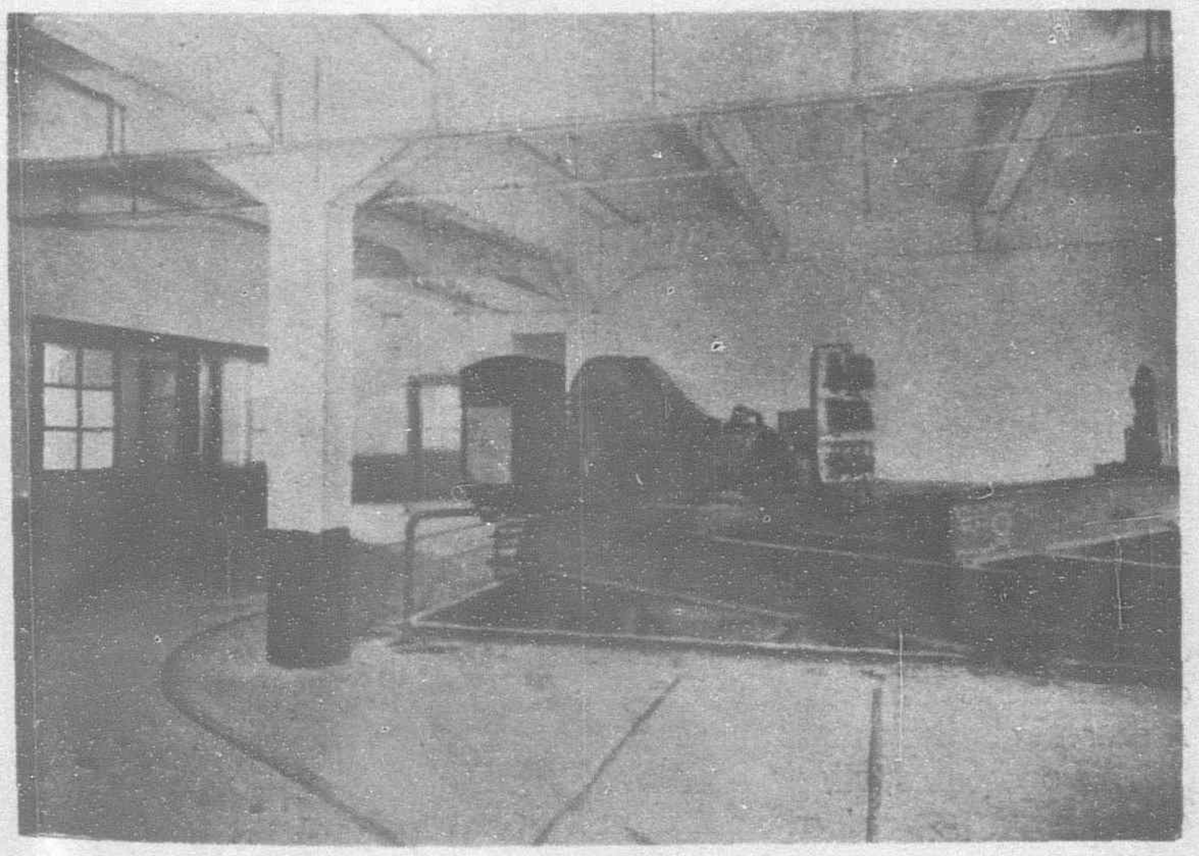
Each floor is equipped with two fire hydrants and reels holding 280 feet of hose. There is also an automatic electrically driven fire pump. All doors, windows and ventilating ducts are fireproof. An automatic fire alarm system conveys instant warning to the department and to the night watchmen's rooms. The ventilating ducts are equipped with damp-proof doors which, when shut, keep out dampness, especially in the rainy season. A feature of the Tokyo warehouse is the arrangement on the ground floor for draining and collecting molasses from the bags of stored sugar. Each room has several collecting receptacles into which the molasses flows through channels arranged for this purpose.

The mechanical equipment consists of one freight elevator of 4,000 lbs. capacity with a speed of 150 feet per minute. There are also seven one-ton mono-rail hoists, ten half-ton hoists, two spiral chutes and one passenger elevator. The fifth floor is partitioned into about ten rooms, used as offices for customs and internal revenue officers, customer's agents and rest rooms.

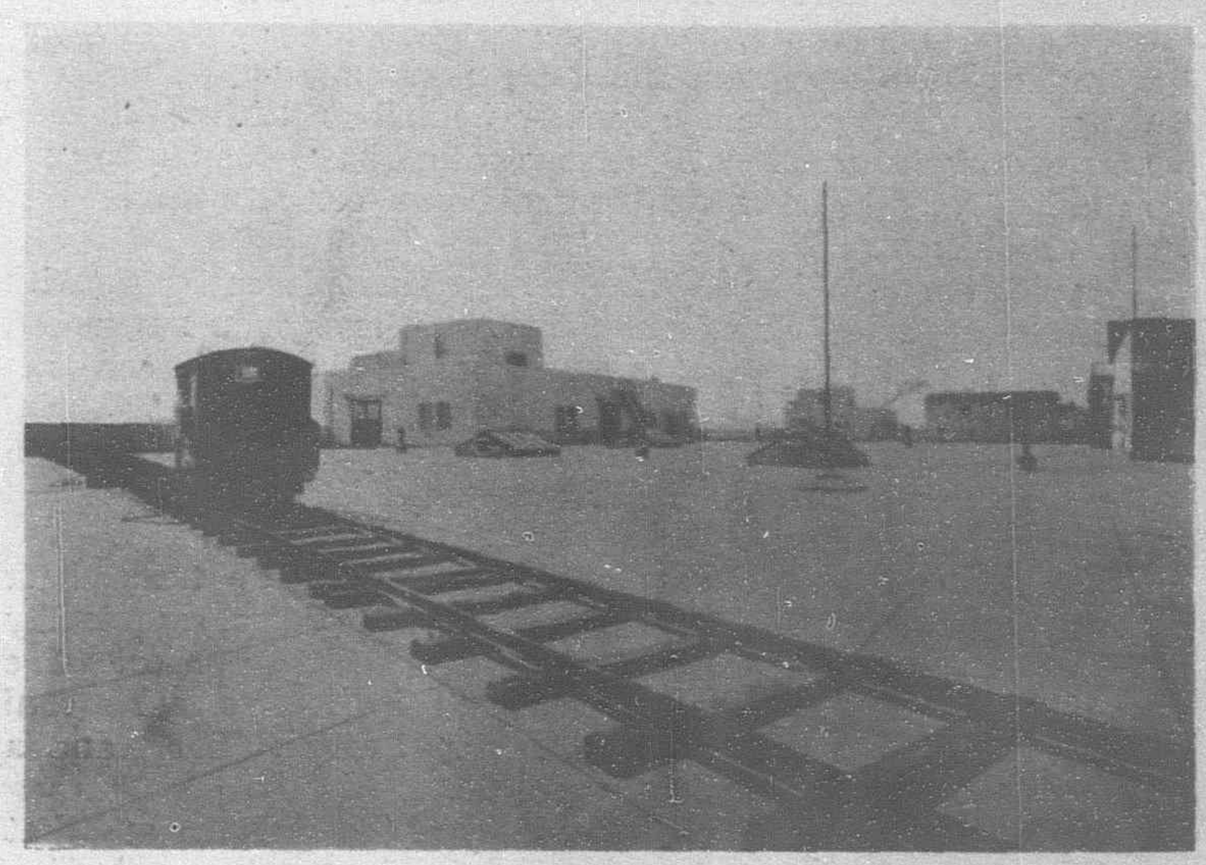
Yokohama Warehouse

Work on the Yokohama warehouse was commenced in December, 1926, and was completed in December, 1927. This building standing within the Customs Compound, is a four storey reinforced concrete structure about 60 feet high and with a storage space of 9,260 sq. yds. This building has an engine-room on the roof, and a transformer room on the first floor, electrically equipped the same as the Tokyo warehouse. The fire extinguishing system is confined to one hydrant on each floor with the necessary hose reels. The mechanical equipment consists of one goods elevator of 6,000

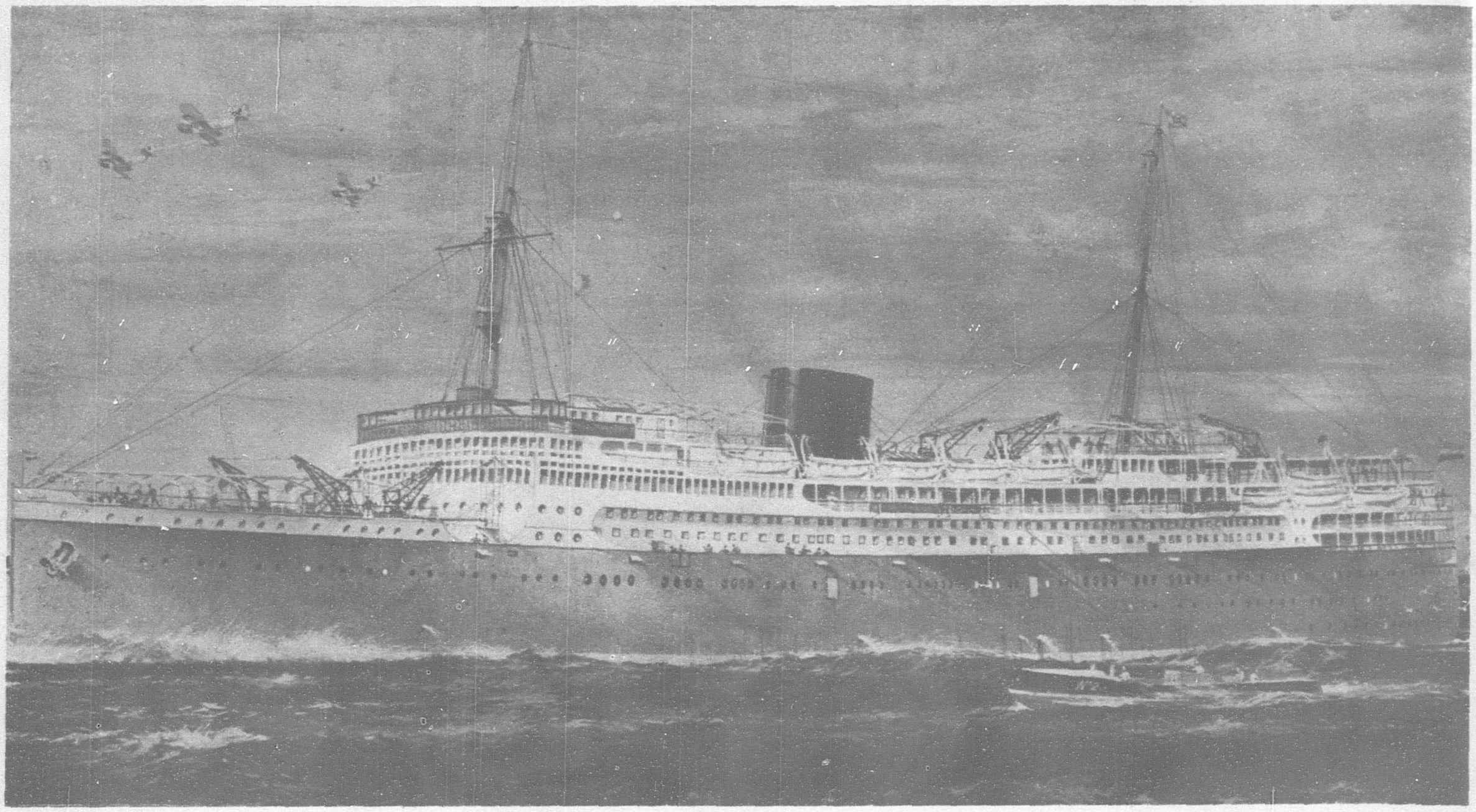
(Continued on page 460).



Elevator Hoist



View on Roof



New Rotterdam Lloyd Motorship "Baloeran"

New Dutch Vessels for the Far East

RECENTLY the new passenger motorship *Baloeran*, built for the Rotterdam Lloyd Mail service between Rotterdam and Batavia, by the Fijenoord Shipbuilding and Engineering Company, Rotterdam, underwent successful trials. The vessel was designed by the De Schelde Royal Shipbuilding Company of Flushing, who also supplied the propelling machinery.

The following are some of the most interesting particulars of the new vessel. Length, overall 575 feet, breadth 70 feet, and depth 82 feet from top of keel to navigating bridge. Accommodation is provided for 238 first class passengers in 78 2-berth and 82 1-berth cabins, including two suites de-luxe and 12 semi-luxe cabins with bathrooms, for 280 second class passengers in 180 deck cabins, for 70 third class, and a number of fourth class passengers. The main mast has been placed abaft the navigating bridge, insuring a clear view forward, and with the short elliptical funnel gives the vessel a very individual appearance.

Sixteen Fleming patent lifeboats, with hand-propelling gear, and a motor boat are carried under Columbus davits; the lifeboats are designed to carry 70 persons each, but 67 persons to each boat suffice to accommodate the maximum complement of passengers and crew.

Navigation aids include a Sperry gyroscopic compass, with repeating compasses, automatic helmsman, and course recorder, submarine signalling apparatus, which can be worked in conjunction with the radio-direction finder, echo sounder of the Langevin-Florisson type, and electric chronometer, operating forty-five repeater clocks on board. The windows of the bridge are equipped with clear view screens.

The radio equipment includes a 2 kw. long wave transmitter for wave lengths of 600, 800, 2,000 and 2,400 meters, supplied by the Nederlandsche Seintoestellen Fabriek, a 250 watt short wave transmitter for wave lengths of 23.6 and 36 meters, a Marconi marine-type receiver, a Marconi D.M.F. direction finder, and a band repeater feeding ten loud speakers.

The main difference in the machinery of the *Baloeran* and that of her predecessor, the motorship *Skibajak* is due to her having increased power and to the adoption of electric-driven turbo scavenging pumps. The main and auxiliary motors are constructed to the very latest Schelde-Sulzer designs. The whole installation is housed in one single engine room and comprises :—

(*a*) Two Schelde-Sulzer main diesel motors, each of 7,000 s.h.p. at about 102 revolutions per minute.

(*b*) Four Schelde-Sulzer auxiliary diesel motors, each of 780 s.h.p. at 180 revolutions, and coupled to direct current dynamos of 510 kw. supplied by Smit-Slikkerveer, Holland.

(*c*) The requisite auxiliary machinery which, with the exception of the auxiliary lubricating pumps of the auxiliary motors is electrically driven.

The main motors have each 10 cylinders 760 mm. diameter by 1,340 mm. stroke, and the compressors are incorporated with these motors. Fresh water is used for piston cooling—sea water for cylinder cooling. The starting gear is situated on the forward side of the compressors. Starting is effected by means of an air-driven servo-motor, as is also the reversal of the motors.

In the immediate vicinity of the starting gear the telegraphs are located, as are also the fuel oil pumps, these being driven by means of levers coupled to the compressor crossheads.

The desirability of utilizing the power of the main motors as far as possible solely for propulsion was responsible for the adoption of electric-driven rotary scavenging pumps. Two similar units of Brown Boveri's make (of which one is in reserve) supply the scavenging air.

The auxiliary motors each have six cylinders 320 mm. diameter by 660 mm. stroke, and drive their own scavenging pump, lubricating pump and compressor. For cooling the pistons lubricating oil is used, and sea water for cylinder cooling.

The cooling water supply for the main and auxiliary motors is delivered by a horizontal centrifugal pump with a capacity of 750 cubic meters per hour, driven by a Laurence Scott motor of 85 h.p. A second similar pump serves as a spare.

The piston cooling water is supplied by a Drysdale self charging center pump of 125 cubic meters per hour capacity drawing from a tank in the ship's double bottom and discharging to the telescope pipes of the piston cooling system. The water heated in the piston

then returns to the double bottom through telescope pipes and through a fresh water cooler with filter.

Each of the main motors drives four piston pumps at its forward end—one lubricating pump, one crosshead pin lubricating pump, one fuel oil transfer pump, and one sanitary pump. The sanitary pump on one of the motors serves also as drinking water pump. The drinking water is discharged through a Buhring filter apparatus to a drinking water tank located on the sports' deck.

Fuel oil is stored in five double bottomed tanks, and in the rolling tank. One of the double-bottom tanks is arranged for storage of purified oil. Three double Sharples centrifuges are fitted for purification of the fuel oil, each having a capacity of three tons per hour. Sharples centrifuges are also used for the purification of the lubricating oil, two for the main motors and two for the auxiliary motors. The air necessary for starting the main and auxiliary motors is stored in two air cylinders each with a capacity of 23 cubic meters at a pressure of 25 kg. per sq. cm. There is also fitted a high pressure air battery consisting of 13 h.p. air flasks each of 1,200 litres capacity in which air of 70 kg. per sq. cm. is stored.

While manoeuvring the air supply is maintained by means of two manoeuvring compressors. Each compressor has a capacity of 550 cubic meters free air per hour and discharges against a pressure of 70 kg. per sq. cm. These are driven by a Laurence Scott electromotor of 150 h.p. All electro-motors are supplied with direct current of 220 volts. The ship's lighting system is, however, only 110 volts, and for the transformation of the 220 volt currents into the 110 volt, two converters are placed in the motor room, each of 150 Kw. made by Smit, Slikkerveer, Holland.

At the top of the engine room are two travelling cranes, each carrying an electric Demag tackle of five tons lifting capacity.

The exhaust gases from the main motors are led first through a common silencer housed in the funnel. They also pass through a patent soot and spark arrester (Vicker's patent) before escaping into the atmosphere. The exhausts from the auxiliary motors are also connected to this soot arrester.

The exhaust gases from the auxiliary motors and part of the exhaust gases from the main motors can also be passed through a waste heat boiler producing steam of 0.5 kg. per sq. cm. pressure which steam is employed for heating the fresh and sea water for the baths and also for central heating in the cabins de luxe as well as for its use in the galleys. The heating of the berths, saloons, and passages is accomplished electrically.

Motorship "Tanimbar"

There was launched at the end of May from the Stannergate yard of the Caledon Shipbuilding & Engineering Company, Limited, the *Tanimbar*, a motorship built to the order of the Stoomvaart Maatschappij "Nederland" Amsterdam. The vessel is of the following dimensions:

Length, between perpendiculars, 465 feet.
Breadth, moulded, 62 feet.
Depth, moulded 36 feet 3 inches
Gross tonnage, 8,230 tons.

The vessel has been built to Lloyd's Register of Shipping, to the Dutch Scheepvaart Inspectie, and has been specially designed for trade in the Far East, special accommodation being provided for the passage of pilgrims.

The *Tanimbar* is divided into six main holds, and one has been constructed to serve as a deep tank, while the cargo loading and discharging appliances are all of the most modern design. There are fourteen derricks with a range of lifts from three tons to 40 tons, and these are operated by eleven electrically driven winches of special design, supplied by Messrs. Laurence Scott & Company, Limited.

Other deck machinery consists of six electric deck cranes, capable of lifting three tons, and are supplied by Messrs. Stork, Hengelo, Holland, two electric capstans and an electrically driven windlass by the Atlaswerke, A.G., Bremen. The steering gear is electrically driven, and has been supplied by Messrs Brown Bros. & Company, Limited. It is controlled by telemotor. The refrigerating machinery has been supplied by N. V. Grasso's Machinefabrieken,'s-Hertogenbosch, Holland.

The extensive bituminous work about the vessel has been supplied by Messrs. William Briggs & Sons, Limited. The vessel is fitted with an Oertz patent rudder.

The propelling machinery, which consists of one set of 8-cylinder, two-cycle, single-acting reversible diesel engines, has been constructed by Messrs. Sulzer Bros., Winterthur, and will be installed in Dundee by the shipbuilders.

"Johan van Oldenbarnevelt"

Successful trials have been run by the new Nederland Steamship Company's motor liner *Johan van Oldenbarnevelt*, built by the Netherland Shipbuilding Company, for the Amsterdam-Batavia Mail Service. The vessel is of 586 feet length, 74-feet 9-inches breadth, and 36-feet depth, her gross tonnage being 19,040, and net tonnage 11,335. She is propelled at over 18 knots by two ten-cylinder Sulzer diesel engines, with cylinders of 30 inch diameter and $52\frac{3}{4}$-inch stroke, constructed by Messrs. Sulzer Bros. at Winterthur, each developing 7,000 shaft h.p.

Her two squat funnels give her an entirely different appearance to the Rotterdam Lloyd latest motorship *Baloeran*, which is slightly smaller.

At the luncheon on board during the trial trip, the senior director of the steamship company said that the Nederland Company during the past ten years had spent on construction over 105,000,000 guilders. On her trials the ship reached a speed of 19.2 knots, *i.e.* 1.2 knots more than the stipulated contract speed. Noteworthy is the arrangement of the first and second-class saloons, which with the exception of the dining saloons are situated between the cabins on the C deck; this deck also serves as a spacious promenade deck. On the deck above are first-class cabins, whilst the other first and second-class rooms are situated in the two decks below. On the lowest continuous deck are the first and second-class dining saloons, kitchen and accommodation for the third and fourth-class passengers. The vessel has accommodation for a total of 620 first and second-class passengers, 64 third class and 50 fourth class. There are, however, a large number of cabins which may be used for either first or second-class passengers, and also for either second or third-class passengers. In order to suit the special service for which this ship is intended, ample accommodation is provided for children and Javanese servants. The machinery built in the Sulzer Works at Winterthur comprises two ten-cylinder single-acting two-cycle Diesel engines with a total output of 14,000 B.H.P. and four six-cylinder single-acting two-cycle auxiliary Diesel engines. The auxiliary engines, one of which is of the airless injection type, have a total output of 2,600 H.P. and drive compressors and dynamos. In the engine room there are also two refrigerating compressors which, as well as the whole refrigerating plant, have been built by Sulzer Brothers, Winterthur. Each of the two compressors, one of which serves as stand-by, has two stages and is rated at 240,000 B. Th.U. per hour. On a liner like the *Johan van Oldenbarnevelt*, which has to pass through the tropics, the cold rooms for the storage of provisions must be of considerable capacity. There are 18 various cold rooms and cold cupboards with a total capacity of 19,000 cu. ft. The refrigerating equipment also includes an ice tank capable of making one ton of opaque ice daily, and drinking-water coolers with a capacity of 1,300 gals. per day.

New Holland-Amerika Motorship for Pacific Coast

On Saturday, May 17, the new twin screw motorship *Damsterdijk*, under construction for the Holland-America Line's north Pacific Coast's service was floated off the building floor in Wilton's building dock at Schiedam. The *Damsterdijk* is a duplicate of the motorship *Delftdijk*, which was delivered to the same owners in October last year, and is of 490 feet length between perpendiculars, 64-feet 6-inches breadth, and 40-feet depth, having a deadweight capacity of about 12,000 tons on a mean draught of 30 feet. A service speed of 14 knots will be attained by two eight-cylinder four stroke cycle engines of the Harland & Wolff-Burmeister and Wain type, each developing 3,250 s.h.p. at 90 revolutions per minute. For the supply of electrical current four diesel generators of 150 Kw. each are installed.

Accommodation for passengers is provided in ten cabins with two and three berths each, running water and electric heating being fitted in all cabins, which each have their private bathroom. There will also be a dining saloon, lounge and library. About 150,000 cubic feet of cargo space is refrigerated.

New Blue Funnel Motorships

For the Asiatic Trade

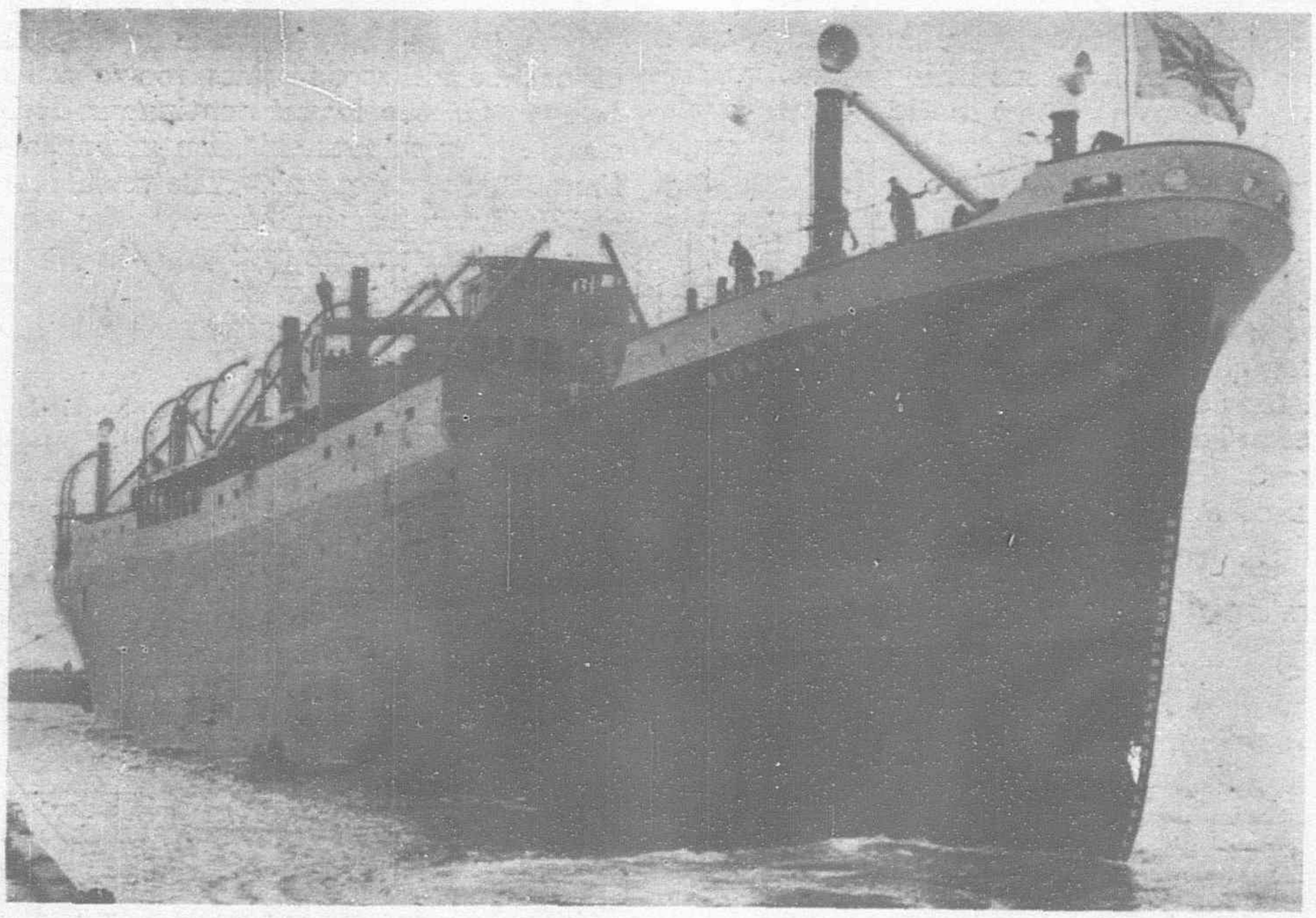
TOWARDS the end of February Messrs. Scott's Shipbuilding & Engineering Company, Limited, of Greenock, launched from their Cartsburn Dockyard, the twin-screw motorship *Clytoneus* an addition to the Blue Funnel Fleet, owned by Messrs. Alfred Holt & Company, Liverpool.

This has been followed by the launching of the *Myrmidon* at the same yards.

These contracts are a mark in the continuation of a long established connection between the owners and the builders, Messrs. Scotts having been entrusted with their first Holt contract in 1859, and since then having launched 78 ships for Messrs Holt. In addition they are at present engaged on another three contracts for the same firm, two of which are sister vessels to the *Clytoneus*, while the third is of considerably greater tonnage.

The *Clytoneus* and *Myrmidon* are not amongst the largest of Messrs. Holt's ships, built for them by Messrs. Scotts, as she has been designed for the special passenger and cargo trade for Java, but her equipment is of their usual high standard.

The vessels have a length on waterline of 426-feet 6-inches, a breadth of 56-feet, and a depth of 31-feet 9-inches, and is of about 6,400 tons gross register. The scantlings are all to the owners' special high standard of strength, but the constructional material is of special steel of the high elastic quality which was first adopted by Messrs. Holt in 1924 for the *Prometheus*, which has proved highly satisfactory. It results in a considerable increase in carrying capacity.



Launch of the New Blue Funnel Motorship "Myrmidon" at Scotts' Shipbuilding Yards at Cartsburn

The arrangements, generally, include two complete steel decks, long center-castle, poop forecastle, and long deck houses above the center-castle, containing commodious accommodation for the officers and the engineers. All the exposed decks are fully sheathed, and provision has been made in the 'tween decks and superstructures for the carriage of pilgrims. The cargo arrangements are an outstanding feature of the vessel, twenty-two electric winches of the owners' special design having been arranged to work 26 derricks, one of which is capable of handling 60 ton lifts.

The vessels comply fully with the British Board of Trade for Passenger-carrying, including subdivision of holds, life-saving appliances, emergency electric lighting, etc., the navigating arrangements representing the highest and latest standard, and, of course, the vessel is designed with the special type of protective bow which was introduced by Messrs. Holt about twelve years ago, with a view to reducing damage to another ship in the event of a collision; this feature has been favorably commented upon by many authorities and is now extensively adopted by several other companies.

The propelling machinery is fitted amidships, and possesses more than usual interest, in that the main engines represent a break-away from any specialized type, and have been built to the owners' specified requirements in association with Messrs. the North Eastern Marine Engineering Company and the hull builders. The installation comprises two sets of six-cylinder four-stroke single-acting engines, arranged to work with the Buchi turbo superchargers. Each engine exhausts into a separate charger, which in turn delivers air under pressure to the inlet valves on the cylinders, thereby providing for very efficient scavenging and increasing the power output.

The cylinders are 620 mm. diameter each, and have a stroke of 1,300 mm.; the total brake horse power developed by the two engines at full power is 5,500 at 138 revolutions per minute. A three stage air compressor for the injection of the fuel is fitted at the forward end of each engine. Forced lubrication is supplied to all bearings, and the pistons are oil cooled.

All the auxiliaries in the ships, including deck machinery, are electrically driven, the current being supplied by four diesel-driven electric generators, each having an output of 100 Kw. at 220 volts. The steering gear is of the electric hydraulic type, and is provided with an air engine as a standby, which automatically comes into operation should the electric current fail.

The whole installation has been constructed in accordance with the highest requirements of the Board of Trade.

The Holt Steamer "Maron."

The trials of the steamer *Maron* constructed by the Caledon Shipbuilding & Engineering Company, Limited, of Dundee, to the order of Messrs. Alfred Holt & Co., Liverpool, took place on April 30. The *Maron* has been specially designed for Messrs. Alfred Holt & Co.'s Eastern trade, and is of the following dimensions: Length b.p. 426-feet 6-inches, breadth moulded 66-feet, depth, moulded 31-feet 9-inches, and with a gross tonnage of 6,700. Arrangements have been made for a limited number of passengers to be carried, and a large number of pilgrims can also be accommodated.

The cargo gear consists of 26 derricks with a range of lifts from two to 50 tons. Power to these derricks is supplied by 22 electrically driven winches of the owners' special design. The steering gear is of the "Hele-Shaw-Martineau" electric hydraulic type, and has been supplied by Messrs. Hastie & Co., Ltd., Greenock. An auxiliary emergency air engine has been fitted to the steering gear and is of entirely new design. The control of the steering gear is maintained by telemotor. The refrigerating machinery is electrically driven and has been supplied by the Liverpool Refrigerating Co., Ltd. The galley and pantry cooking appliances are of the latest electric type, and have been supplied by Messrs. Wilson, of Liverpool.

A description of the shop trials of the engines is of interest. The trials, which took place at Wallsend-on-Tyne with the object of ascertaining the heat flow to liners, heads, and pistons, as determined by the measurement of the heat carried away by the cooling media, when the engine was running at various powers at

constant speed. The nominal speed of the engine is 138 r.p.m., giving a piston speed of 1,177 feet per minute, but for the trials it was decided that the revolutions should be 115 r.p.m., so that data obtained at a lower piston speed would be available for comparison with other engines.

The engine which is of the four-stroke, single-acting type fitted with the Buchi system of exhaust turbo-charging, has six cylinders of 620 mm (24.4 inches) bore and 1,300 mm. 51.2 inch stroke. The nominal power of the engine is 2,750 b.h.p. at 138 r.p.m., and the engine has been specially designed to work on the Buchi system at this power. The flywheel, which is secured to the after end of the crankshaft is 3.9 feet in diameter, and weighs 2.58 tons.

Blast air is supplied by a three-stage compressor of the Steeple type driven by an additional crank at the forward end of the crankshaft. The compressor is fitted with a piston rod and cross head, and the h.p. cylinder is entirely separate from the l.p. cylinder—the h.p. piston being attached to the l.p. by a rod passing through a gland in the l.p cylinder cover.

One fuel pump is fitted for each cylinder. The fuel pump block is situated at the front of the engine between cylinders Nos. 3 and 4. The fuel pumps are actuated from the crankshaft through gearing. The blower suit which was manufactured by Messrs. Brown, Boveri, of Baden, consists of single wheel exhaust gas turbine directly coupled to a two-stage blower.

The main engine has two exhaust manifolds. Cylinders Nos. 1, 2, and 3 connected to one manifold, and Nos. 4, 5, and 6 to the second manifold. These manifolds are led to two separate inlet branches on the exhaust gas turbine casing. There is a common outlet from the turbine leading to the atmosphere. The blower discharges the air under pressure into a common main, from which branches are taken to the inlet valve in each cylinder head. Following the usual Buchi practice, the timings of the inlet and exhaust valves are such that there is an appreciable overlap, which results in the scavenging of the cylinder clearance spaces of exhaust gases.

During the shop trials the turbo-blower was supported on a temporary collecting pipe. Readings of the meter and of the thermometer were taken every fifteen minutes.

The piston cooling oil was supplied by a separate electrically driven pump arranged so that it could take its succession through a strainer either from two calibrated measurement tanks or from the oil storage tank. The oil discharged from the pump, after passing through a filter and cooler, was led by telescopic pipes to the hollow piston rods, which were fitted with internal pipes. The oil passed up the rods, on the outside of the internal pipes to the pistons, returning through the internal pipes to collectors attached to the engine columns. The oil from the collector of each cylinder was led to an inpsection trough, which communicated with the common drain pipe leading back to the oil tanks.

For ascertaining the quantity of the oil passing through the pistons the pump was put into communication with the measuring tanks, which had previously been filled with oil, and the quantity of oil drawn from the tanks over a period of about 20 minutes was recorded. Two records were taken during each trial.

The inlet temperature of the cooling oil was taken in the common supply pipe as close as possible to the engine, and the outlet temperatures by thermometers placed in the inspection troughs. In the record sheets included in this report the piston-oil outlet temperatures given are the means of the outlet temperatures from the six pistons. Those temperatures were taken every 10 minutes.

The blower suction pipe terminated in an enlarged vertical pipe, about four feet diameter and 10 feet in length, in the top end of which was fitted a shaped nozzle of wood, having a mean diameter of 19.75 inches. The nozzle co-efficient was taken as 0.965. The pressure drop through the nozzle was measured by an inclined tube manometer, filled with paraffin, which was calibrated before the trials. The temperature of the air entering the nozzle was recorded by a thermometer placed near the top of the enlarged vertical pipe. The pressure in the blower-discharge pipe was measured by means of a U-tube filled with mercury.

A large tank, in which was fitted a throttle plate containing an orifice 4.503 inches diameter, was employed for measuring the air passing to the blast compressor. The co-efficient assumed for the orifice was 0.59. The pressure drop across the orifice was measured by means of a manometer filled with paraffin. A thermometer was placed near the orifice for measuring the temperature of the in-going air. Records were taken every ten minutes.

The pressure of the exhaust gases entering the turbine was recorded by a U-tube filled with mercury. With the object of recording directly the means of the pressures of the two exhaust pipes leading to the turbine a connection was taken from each pipe to a Y-piece, and the common leg of the Y was conducted to one limb of the U-tube.

The temperatures of the gases entering the turbine were recorded by two iron-constantan thermo-couples and one nitrogen-filled thermometer in each inlet pipe. The couples, the leads from which were connected to a multiple point indicator, were calibrated before the trials. The glass thermometers were calibrated after the trials, and any necessary corrections have been made in the tabulated results. The means of the readings of the four thermocouples and the two glass thermometers have been taken as the exhaust temperature for the purpose of estimating the adiabaric heat drops of the turbine.

The pressure in the exhaust outlet pipe from the turbine was recorded by a Y-tube filled with water. The pressure was found to be approximately atmospheric for all trials. The temperature of the gases leaving the turbine were also registered by two thermocouples and one nitrogen-filled glass thermometer. The revolutions were recorded by a tachometer driven from the turbine shaft. The records were taken every ten minutes.

Samples of exhaust gases were taken continuously from the exhaust pipe leading from the turbine. Two samples were taken simultaneously, the total volume withdrawn during each trial being about ten litres. Each sample was analyzed in the works laboratory immediately after trial, and the mean results are given in the specially prepared tables.

The water and air measurements, the pressures and the temperatures were recorded by six senior students of the Armstrong College, and the necessary indicator diagrams were taken by the N.E.M. Engineering Company record staff.

The fuel oils were analyzed by Messrs. J. & H. S. Partinson, who report as follws :

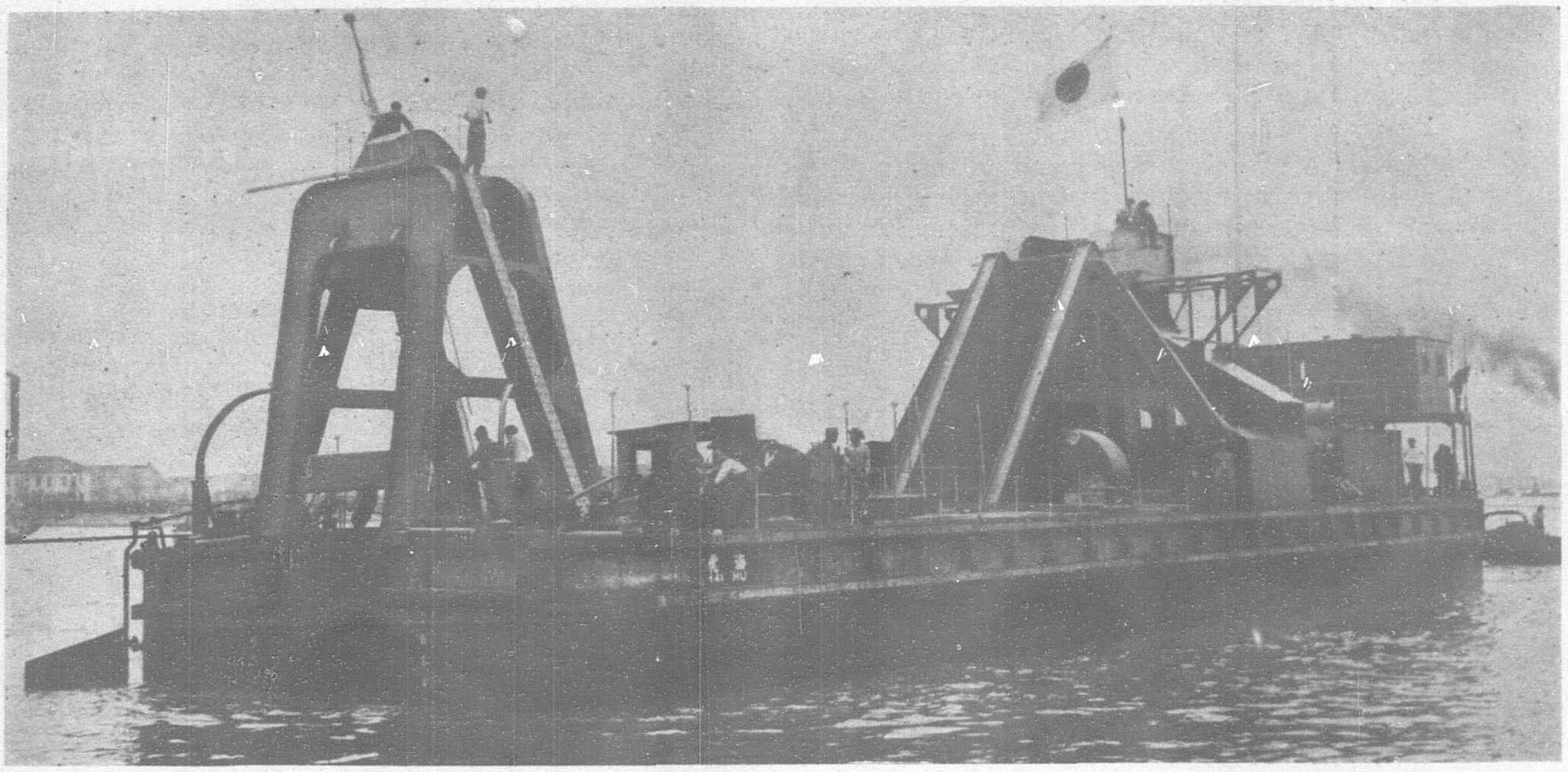
Carbon	86.77
Hydrogen	12.57
Oxygen	0.14
Nitrogen	0.03
Sulphur	0.49
Ash	none
Water	trace
	100.00

Specific gravity at 15.5°C 0.8725
Flash point, close test 90°C — 194°F
Soft asphalt 0.03 per cent.
Hard asphalt 0.11 per cent
Setting point quite liquid at —24°C — 11° F.
Viscosity Time of flow of 50 c.c. from Redwood's viscometer in seconds at
70°F 47
100°F 38

Calories	Gross	Net
	10,740	10,060
B. Th. U.	19,330	18,110

Lbs of water evaporated from 100°C by 1 lb of the oil
20.0 18.73.

Not only does the new phase of engine make the report of the utmost interest, but it is seldom that so much detail is ever available to the public, and in this case the abridged abstract conveys the most salient points of the voluminous document which has just been published.



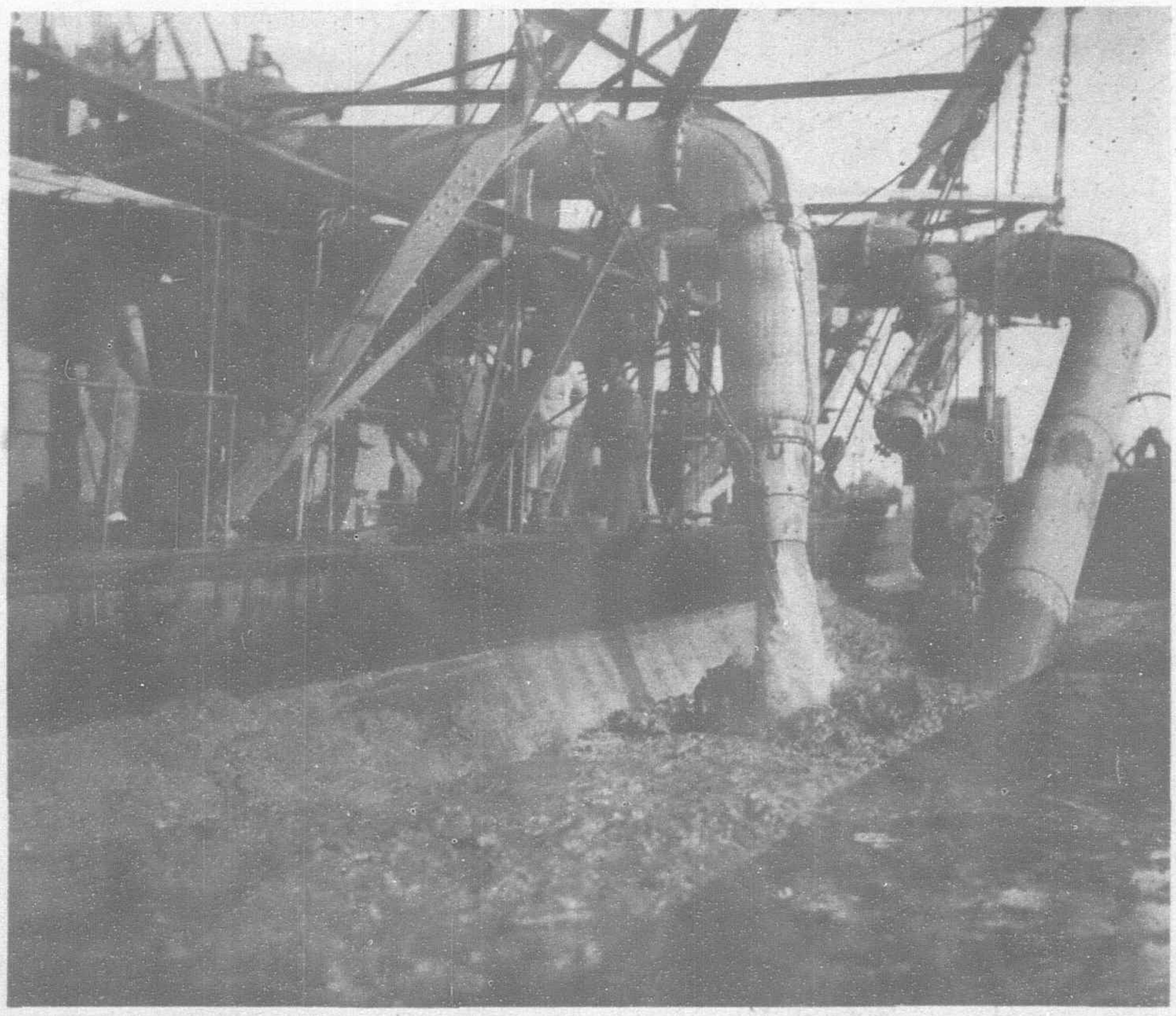
Type of Non-Propelling Bucket Dredge Built for the Whangpoo Conservancy Board by The Shanghai Dock & Engineering Company, Ltd.; The Osaka Iron Works and The Kiangnan Dock & Engineering Works, Length, 110-ft.

The Relation of the Material to Method of Dredging in the Whangpoo River and Yangtze Estuary

By HERBERT CHATLEY, D. Sc. (Engineering), M. Inst. C. E., Engineer-in-Chief, Whangpoo Conservancy Board, Shanghai

In several papers to the Engineering Society of China, the Institution of Civil Engineers, the Society of Engineers and the Junior Institution of Engineers, the writer has drawn attention to the importance of the physical properties of alluvial materials such as sand, silt and clay, in relation to river regulation and dredging. Prof. Terzaghi in his researches has similarly emphasized the necessity of arriving at a sound knowledge of the material in designing foundations ("Erdbaumechanik," Leipzig, 1925).

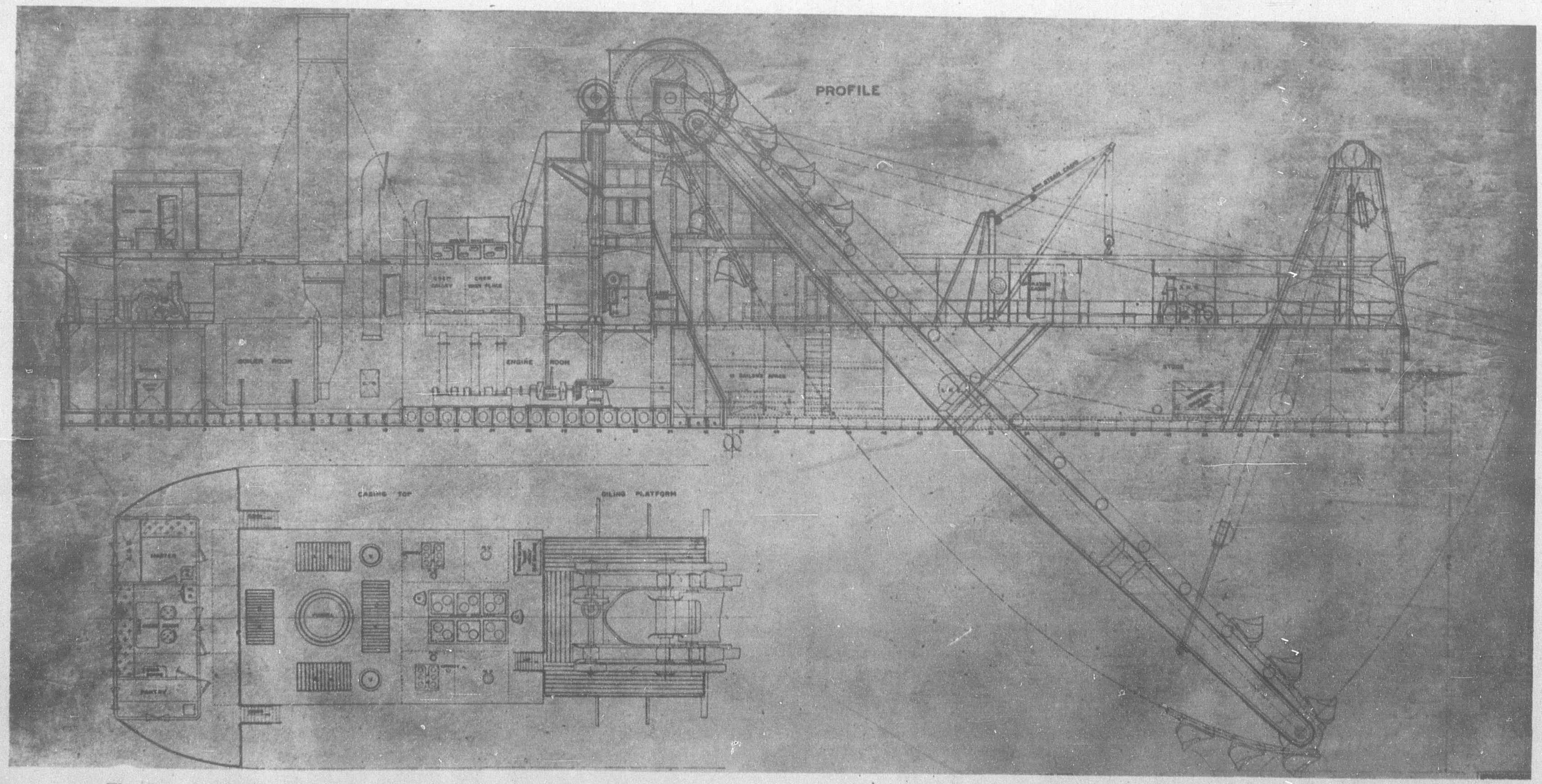
There can be no doubt that without a thorough knowledge of the material to be handled it is almost impossible to prophesy what the results of a dredging project will be, and many otherwise excellent schemes have failed through insufficient attention to this point. According to the official enquiry into the Bombay Back Reclamation scheme (H.M. Stationery Office, 1927), the consistency of the soil was there a vital question, and the practical failure of the suction dredgers to produce the anticipated output imperilled the whole scheme. Descriptions such as "soft clay" and "stiff or unctuous clay" were shown to be open to misconception.



Pumping Barge During Official Trial of Dredge Built by the Shanghai Dock & Engineering Co., Ltd., discharging 1,200 cubic meters of Mud per hour, with a Coal Consumption of 3.08 lbs. per cubic yard. Main Pump Supplied by L. Smit & Zoon

While it is true that machines can be devised to handle almost any material, the cost of construction and operation rises rapidly with the resistance of the material, and at the same time the output peunit of energy dimir nishes. The problem is also complicated by the question of disposal of the spoil. The highest output and lowest unit cost occur with a pipe line suction dredger pumping soft silt through a short floating pipe line, but this is a very special case which rarely occurs. If the spoil must be put ashore, then the pumps must have the necessary power to lift the material over the dyke (in the Whangpoo, say 22-ft. above lowest low water). Furthermore, it will

Whangpoo Conservancy Board Non-propelling Bucket Dredger "Hai Lung II"



The Contract for the Construction of this Dredge was Awarded by The Whangpoo Conservancy Board to The Kiangnan Dock and Engineering Works at a Cost of Taels 270,000, to be completed by February, 1931. Principal Dimensions, Length on Deck, 150 feet; Breadth Moulded, 34 feet; Depth Moulded, 10 ft., 9 in.; Draft, 6 ft. 9 in.; Dredging Depth, 45 feet below the water level; Capacity of Buckets, 23 cu., ft.; Speed of Buckets, Soft Mud, 18 buckets per minute, Hard Mud, 10 buckets per minute; One set of Triple Expansion Engines, 400 I.H.P.; Two Cylindrical Multitubular Boilers, 180 lbs. working pressure, fitted with Houden's Forced Draft. Similar Dredges of the above Type and Capacity have been Furnished the Whangpoo Conservancy Board by the Shanghai Dock and Engineering Company, Ltd. and the Osaka Iron Works.

not usually happen that the place to be dredged is conveniently near to a suitable place for reclamation, and the power increases appreciably with increased length of the pipe line. Weather conditions are also of great importance in floating pipe line work.

Soft silt such as can be easily pumped is, moreover, not usually the material to be removed. By the use of a rotary cutter firmer material can be made pumpable, but this also involves a special engine and a considerable addition of dilution water so that the power required increases in two respects. Sand can be pumped unless very densely packed, but owing to the ease with which it settles a liberal supply of dilution water is required to keep it in suspension. (Effluent from ordinary suction dredgers rarely contains more than eleven per cent. by volume of spoil, giving a mixture density of say 1.1).*

If the distance to which the spoil has to be carried is too great for a pipe line (or there are navigational or climatic objections to a pipe line), the material must be deposited in hoppers (Note : this word does not necessarily connote a bin which can be emptied by doors) either in special barges or in the dredger itself. This spoil must be taken to the disposal place and either be dumped through doors or be pumped out. If the hopper is on the dredger, the dredging machinery is not operating during the transportation but the machinery may be usable for pumping out. If there is much dilution water in the spoil and the solids do not settle rapidly, the hopper load is largely water and much energy is lost in transporting it. This water will, however, facilitate emptying, whether by dumping or pumping. The minimum energy for transportation occurs with solid spoil, and herein is one of the advantages of positive excavators such as ladder (bucket), grab and dipper dredgers, which scoop out the material and deposit it in the hopper with but little water. They also can cut material which would require large energy to be applied to the rotary cutter of a suction dredger, and make a cleaner job of the actual cutting. They can also be used for hard material which is barely pumpable such as gravel, loose rock, etc., but the wear and tear is very heavy.

All these types of dredgers work comparatively slowly over the bottom, and are moved while dredging by winches and mooring ropes or chains attached to anchors, with a traversing and lengthwise motion. In some types, especially the dipper or power-shovel, the dredger may be partially anchored by vertical spuds sliding in housings, which spuds are lifted in series mechanically while the dredger is slewed by side moorings, and so pegs its way along the cut. The principal advantage of this last method is the avoidance of long head and stern moorings.

Another type which is of great interest but rather uncertain performance is the self-propelling drag suction type which can work without moorings, the propellers forcing the spoil into the suction pipe, or rather forcing the suction pipe into the cut. This arrangement enables a rather thick mixture to be pumped, and the vessel can better withstand marine conditions. This is the type which is used in sand on the Taku Bar (Hai Ho, North China) and has been contemplated for the Yangtze Estuary.

The practical problem which the engineer has to handle may be expressed as follows:—

A certain material in a specified locality has to be removed to a specified depth over a specified area to a specified place. What is the most economical appliance and method ? In many cases a further condition occurs as to the time limit or the form of the individual cut, especially if reaccretion is serious.

The opinion of dredger builders as to the most suitable type is often of little value, as each firm is persuaded of the ability of its particular machine to do almost any job and to handle almost any material. Any machine may in fact be able to handle the material to some extent but, broadly speaking, the builders have only a vague idea of the unit costs of dredging, since these depend enormously on the local conditions and only affect the builders indirectly.

In the Whangpoo a definite practice has become established of using for major work bucket dredgers which discharge into steel mud lighters. These are towed to a mud pump. At the mud pump the mud is liquefied by the injection of as much as eight times additional volume of water. The mixture is pumped through a 28-in. pipe line into large dyked-in basins, where it settles, the surplus water being drawn off over a weir and returned to the river. Judging by the action of the mud pumps on the mud in the barges, simple suction would not excavate the Whangpoo material, and if suction dredgers with cutters were used, so much water would be needed to transport the mud to the hoppers that the latter would only contain a rather small percentage of mud. Drag suction dredging has not been tried in the Whangpoo, except many years ago on a small scale and with unknown conditions, and is of doubtful value, although it nevertheless appears to be the most likely method for use on the Yangtze Bar. Pipe line dredgers have not been used on the Whangpoo because of the inconvenience to traffic, and the distance between the places to be dredged and the simultaneously available areas for reclamation, which distance is often several miles, but there can be no doubt that with cutters they would operate well if the conditions were suitable.

Grab dredgers are used for riparian dredging in the Whangpoo simply because they are more convenient in relation to traffic. They do not cut so well as the bucket dredgers, are intermittent in action, make an irregular cut, are very liable to small breakdowns, and the unit costs are appreciably higher, but they have shorter moorings and can work easily up against a wharf. In old undisturbed mud, heavy whole tine grabs are necessary. In usual reaccretion, half tine grabs can operate. In very soft fresh reaccretion, plain grabs can be used. The output with heavy whole tine grabs is only about half that with plain grabs if full grab loads are obtainable.

Dipper dredgers have not been tried. They would undoubtedly cut as well as bucket dredgers and better than grabs, but the overhead cost is high. Unless they have spuds the moorings are nearly as troublesome as those of bucket dredgers, and they do not cut continuously as does a bucket dredger. As far as an opinion can be given without trial, they seem to be only economical when the material is too hard for a bucket or grab dredger.

The energy used in the Whangpoo for bucket dredging (digging to say 40-ft. below water level) is about ¾ I.H.P. hour per cubic yard dumped in the barges, depending on the stiffness of the material.† With the hardest material in the Whangpoo (a rather sandy mud) the energy may rise to over 1½ I.H.P. hour per cubic yard dumped in the barges. The buckets are 23 cu. ft. capacity and travel at 12 to 16 per minute. These energies refer to the output of the main engines and a small additional allowance must be made for the auxiliaries and winch engines.

The grab dredgers use about the same energy, but are more expensive to work than bucket dredgers, owing to their smaller capacity, higher capital cost per unit output and higher labor costs per unit output.

The standard barges carry over 350 cu. yards of mud (say 500 tons), and one such barge is towed by a tug of about 300 I.H.P. at a speed through the water of 6 knots. Owing to tidal currents tieing up, etc. the speed over the bottom does not average much more than 4 knots, so that the energy per cubic yard-sea mile is about ¼ I.H.P. hour. Mean length of transport is say 5 sea miles, so that including empty returns some 2 I.H.P. hour is used per cub. yard transported. The mud pumps use about 2 I.H.P. hour per cu. yard of mud pumped, injecting water and lifting the mud with say eight times the volume of water to about 22-ft. above L.L.W. and forcing the mixture to a distance of say 2,000-ft., with a velocity of about 10-ft. per second.

About the same power (2 I.H.P. hours per cubic yard) would be necessary in a drag suction dredger, for alternately dredging and cruising to the dumping point.

Thus about 5½ I.H.P. hour is actually used to dredge, transport and pump ashore a cubic yard of mud, or allowing for auxiliaries, loss of time, etc. say 7 I.H.P. hour, or say 21 lbs. of coal, or say 1/100 ton, which at say Tls. 10 per ton is Tls. 0.10‡ for coal alone.

Labour, stores, overhead, repairs, interest and depreciation raise this to about Tls. 0.30, not including the cost of dyke building, bunding, drains, etc. The gross cost of dredging and mud disposal is at least Tls. 0.40 per cubic yard, but depends very much on the length of haul and the facilities for reclamation.

The cost of reclamation (dyking and pumping) for large fills with dykes of moderate height is about Tls. 0.20 per cubic yard. Some of the Whangpoo Conservancy Board's costs are recouped

---

* Eleven per cent of spoil means only about six per cent by volume, or 15 per cent. by weight, of actual solid grains, as there is already water in the spoil.

† These measurements are all as taken in the barges. A cubic yard in situ on the bottom expands perhaps 40 per cent. in the barges, but obviously no precise determination can be made from the in situ measurements. The formula given in Molesworth's Pocket Book (27th Edn. p. 336) agrees fairly well with those figures for the energy.

‡ Tls. 1 (one Shanghai Tael) in 1928 has a value of about 2s/7d, so that Tls. 0.10=say 3¼d.

by payment for contract reclaimings and riparian dredging, but the charges made are less than cost, and only a small fraction (say 20 per cent) of the work is covered by this contract work.

Assuming a fill to be 12-ft. deep, the quantity of mud per mow (1/6th acre) is about 3,000 cu. yds., so that if raising the land increases its sale value by Tls. 600 per mow, the reclamation could be paid for, but the Board's facilities for raising land are in excess of the demand for such land, and the question is much involved with legal problems as to titles. Owing to the retention of water by the fine (not necessarily colloidal) particles, the filling takes some years to consolidate. Owing to the washing out of the finest (colloid) particles and humus, the surface of the filling takes several years to recover its agricultural value. It is usually too high for tidal irrigation.

In regard to the output and unit costs, it is of course desirable that all the vessels shall be working continuously, but the variation in the length of haul makes it practically impossible to attain this ideal. For very long hauls the dredgers or pumps have to wait for barges, and for short hauls the barges have to wait for places alongside the pumps or dredgers. The latter condition is generally the more economical than the former, but involves a surplus of tugs and barges. With the present equipment there is a balance when the haul is about four miles, but for several reasons beyond the Board's control longer hauls have prevailed during the last two or three years so that the dredgers and pumps have not been able to work to full capacity. Also, owing to labor conditions, the working hours were reduced in 1927 from 12 to 11 per day. Double or even treble shifts would enable output to be appreciably increased, but would involve special arrangements for accommodating or transporing extra crews. Working in the dark is also difficult, and would necessitate much special lighting and precaution against collision. The control of the distribution and drainage in the reclamations during darkness would also be a serious question.

Having thus sketched the general operations involved, the writer will proceed to consider the question of the material The density of the actual mineral grains of alluvium such as that of the Yangtze delta is almost always about 2.75. In considering the packing of the grains, it is most convenient to use Terzaghi's "pore coefficient," which is the ratio of the free air or water space to the volume of the solid grains. (see Chatley on the "Physical Properties of Clay Mud," Soc. of Engineers, 1922, and on "The Physical Properties of Clay" Eng. Soc. China, 1923, Vol. XXII, in which this coefficient, called there w_3, was used three years before Prof. Terzaghi's book appeared),*

The pore coefficient ε indicates the free space in relation to the solid volume, and is the best factor to use since it is referred to the solid volume which is invariable under usual working conditions. For equal spherical particles it may be shown that if $\varepsilon=7$ there is almost perfect freedom for particles to pass each other. If the grain density $r=2.75$, this corresponds to a wet bulk density s of 1.22. This is the observed density of pottery slips and easy discharge from drag suction dredgers. If the particles can just pass by pushing one another aside $\varepsilon=3$, and $s=1.44$. This is the densest mixture which can possibly be moved as a liquid and will require very considerable pressure. Fairly close packing makes ε about 1, and $s=1.875$, and this is the usual maximum density of clay or sand. Very tight packing may allow a density of nearly 2.00. With perfect graduation of size, ε might be reduced to zero, giving thus a density of 2.75, but in heavy clay ε is rarely less than 0.75, and even in argillaceous rocks it usually exceeds 0.25. When the density is less than 1.125 the material is practically as free as water provided the particles are not large enough to settle out quickly; in that case parts of the mixture acquire the higher densities referred to, and so do not flow so freely.

The above rules are generally true for fine materials except when the particles are very small. The surface of each particle (especially in the case of aluminous-silicates which have rather a powerful residual chemical affinity) is covered with a film of fixed water which behaves practically as a solid and is under appreciable compression. Terzaghi has shown that viscosity and surface tension are greatly increased in fine capillaries, and this may reasonably be attributed to the partial filling up of the passage by rigid water. The thickness of this film is about one millionth of a centimetre, and when the particles are less than one ten-thousandth of a centimetre in diameter the relative volume of such adherent ("adsorbed") water is appreciable. As a result mixtures containing such very fine particles show greater rigidity than similarly proportioned mixtures of coarser material. With very pure pottery clays even a mixture containing only 5 per cent by weight of solid shows perceptible stiffness, and with gelatine solutions even one per cent. concentrations do so.† This factor is not so important in the Whangpoo mud as in other places, but it does tend to lower the density of the mixture which may be handled freely. Thus from both the point of view of the easy settlement of coarse particles and, on the other hand, the binding of the water on the fine ones, it is necessary to use plenty of diluting water in the mud pumps. If continuous pressure is applied to the actual mud mixture as in the drag suction dredger, with a short large pipe rather heavy mixtures can be raised, but it is doubtful if a mixture with a density much exceeding 1.25 can be so handled. Since the density in place of the Whangpoo (or Yangtze) mud is usually 1.75 this means an addition of at least 2 volumes of water.‡ In some other rivers (*e.g.* Humber and Severn) the in situ density is only about 1.5, and in this case only 1 volume of water needs to be added. It is said that in some drag suction work an outlet density of 1.33 can be attained, which, if the in situ density of the mud was only 1.5, would involve an addition of only 32 per cent. by volume of dilution water. Such remarkable results can only be expected in places where the mud is very soft (containing much adherent water) and are not to be looked for in the Whangpoo or Yangtze.

The dredgers of this class (Fruhling type) while effective in sand do not lift it so freely as soft mud because of its rapid settlement in the pipes, which means that extra dilution water is required to keep the mixture agitated and to increase the fluidity in the lower part of the pipes where the sand is settling. In order that this type of dredger shall work efficiently, the nozzle must be completely buried (the dilution water is introduced by jets in the nozzle) and the propulsive force on the ship has to cut the mud as well as press the mud into the suction pipe. Hence with a large nozzle in stiff mud a very considerable thrust is required, or the suction pipe will simply anchor the vessel.

The shearing force necessary to cut through the mud is an important factor, and appears to be almost 3 lbs. per sq. in., or say 450 lbs. per sq. ft. This compares with the value of the ultimate skin friction on piles in the Shanghai soil.

An examination of alluvial soils by fractional washings, or by the very ingenious Oden-Keen balance, shows that there are particles of different sizes in varying proportions, so that words like sand, silt, mud and clay are not by any means sufficiently precise to define such material. "Pure" sand is loose coarse material with no very fine grains. "Pure" clay consists wholly of ultra microscopic grains. Between these two limits there is an immense range of varieties with greatly varying facilities for packing and water holding. The average Whangpoo or Yangtze Estuary mud consists mainly of silt particles less than 1/20 millimetre in diameter, a small fraction of larger grains and a small fraction of ultra microscopic particles. In some places a large fraction of fine sand (1 millimetre in diameter or less) occurs. If this predominates the material is loose, but with a fraction (say more than 25 per cent.)

---

* The following relations hold good :—

ε = pore coefficient (w_3), 0 to infinity
r = density of mineral grains, generally about 2.75
s = density of mixture in bulk (1 to 2.75)
w = volume fraction of water in saturated mixture referred to whole volume (0 to 1)
w_1 = weight fraction of water in saturated mixture referred to whole weight (0 to 1)
w_2 = weight fraction of water in saturated mixture referred to weight of mineral only (0 to infinity).

For saturated mixtures :—

$$w=\frac{\varepsilon}{1+\varepsilon}=\frac{r-s}{r-1};\ \varepsilon=\frac{r-s}{s-1}$$

$$w_1=\frac{\varepsilon}{r+\varepsilon}=\frac{(r-s)}{s(r-1)}$$

$$w_2=\frac{\varepsilon}{r}=\frac{r-s}{r(s-1)}$$

$$s=\frac{r+\varepsilon}{1+\varepsilon}=w+r\,(1-w)=\frac{r}{w_1(r-1)+1}=\frac{r(w_2+1)}{rw_2+1}$$

† Alum causes coagulation and rapid settlement. Soda delays settlement. Large changes of fluidity are caused by a small amount of acid or alkali.

‡ If density in situ is 1.75 and the density of mixture is 1.25, we have $1.25=\frac{1.75+x}{1+x}$; $x=2$ where x = volume of added water (in relation to volume of in situ mud).

of the ordinary silt it packs very hard. In other places the very fine material is in greater quantity and the mud is slimy. It is quite feasible to make a fairly accurate mechanical analysis showing the proportions of the grains of various sizes, but still the question of age and pressure must be considered. The mud if long undisturbed on the river bed may be rather tough, but is never so firm as the well-known London clay. Fresh accretion is soft but sticky, while again in the sandy places it may be so incoherent that it crumbles and falls readily out of the dredger buckets. The gradual efflux of water from accretion increases its stiffness.

The Whangpoo practice thus calls for machines with rather a wide range of cutting power, and great caution has to be shown in applying new methods to a material which may show unexpected resistance, on the one hand, and slow settlement on the other. As to the last, more than ten per cent. of the spoil is in some cases lost from reclamations by running away with the water, while in other cases the material will hardly flow away from the point of deposition.

When contracting for a new dredger at a port remote from the building yard, several very difficult problems arise. There is the usual question of national capacity with the complications of different standards of quality for material, conventional methods of construction, labour costs and rates of exchange. The ability to produce the necessary tough materials (*e.g.* manganese steel) for the wearing parts varies in different countries and in different works within any one country. If the dredger is sent out complete, it has to be specially prepared for the voyage, and unless self-propelling needs a powerful tug and the necessary crews. If sent out "knocked-down," there is the extra cost of preliminary erection and disassembling, and the complication of a local erection possibly by men with little or no experience in dredger work. If wholly locally designed and built, there is a chance that the design may be of obsolete character, or even seriously defective, owing to the lack of experience on the part of the builders. It is, therefore, necessary that the mechanical engineer in charge of the job shall have had first-hand experience in the design and construction of dredgers.

In specifying the power required, careful distinction must be made between the main engines, which do the actual work and operate continuously at full power, and the auxiliaries, many of which work only intermittently. Thus if the main engines of a dredger are say 500 H.P., there may be auxiliaries of various kinds aggregating say 150 H.P., but it is misleading to speak of the total power as 650 H.P., since the actual power in operation at any one time may not exceed say 525 H.P.

The most critical question of all is that of trials. It may seem a truism to state that these should be such that the intended working conditions shall be actually realized by the dredger after acceptance, but it is rather necessary to emphasize this very simple principle. The contract should therefore call for an output over a period sufficiently long to be representative, and of such an amount as will assure the subsequent maintenance of the output which the controlling engineer desires actually to secure. Thus, if the civil engineering considerations call for an annual dredging (with single shifts) of 5,000,000 cubic yards, the working time, after all deductions for bad weather, shifting position, breakdowns, holidays, etc., may be taken as say 2,500 hours per annum,* corresponding to an average of 2,000 cubic yards per hour. Delays, etc., call for the average output per full working hour to be raised to say 2,500 cubic yards per hour. In order to allow for the special efforts of the builder to achieve success during the trials, this figure should be raised in the specification to 3,000 cubic yards per hour and finally the builder will, if he is wise, endeavor to achieve say 3,500 cubic yards per hour. In the case of a hopper dredger, the mean output must be multiplied by the ratio of the total operating time to the actual dredging time to find the dredging rate.

Trials should be made actually in the place where the dredger is required to work regularly and under the same conditions as will prevail later. While every possible control should be exercised over coal consumption. steam and vacuum pressure, etc., the main consideration is the actual dredging output (including, of course, the speed when motion is involved). In a pipe line dredger or mud pump, the actual pipe line and the actual material should be used. No substitution of throttled short pipes for a regular pipe line, or of a material different from that to be regularly handled, should be allowed.

* In some countries there is a season where owing to extreme climatic conditions work is almost impossible, and in this case the working time must be correspondingly reduced.

The only case in which this rigorous adherence to actual working condition may be slightly departed from is in the purchase of absolutely duplicate plant after one has given entire satisfaction, but even here the builder should be required to guarantee full repetition of the first performance.

Any unavoidable extra cost in fulfilling these conditions is absolutely worth while, as a dredger which fails even by so little as, say 10 per cent., to achieve the original programme designed for it, is a cause of cumulative direct and indirect expense and dissatisfaction.

The Queen of the Pacific

(Continued from page 447).

service. Torsionmeters, kinetometers, tachometers, long distance thermometers, pyrometers, CO_2 recorders, pneumercators, and other instruments are provided so that the engineer in charge may be able to determine the efficiency of each of the numerous parts of this large installation and thus secure the greatest economy of fuel and reliability of performance.

Notwithstanding the new aspect of the differences which mark this installation as a distinct step in evolution, one cannot help being impressed with the simplicity and directness with which the advance has been obtained.

Successful trials were carried out on the Firth of Clyde when the vessel attained a mean speed of 23 knots on the Measured Mile Trial, the speed power curve throughout showing that a very high propulsive coefficient had been obtained. During a subsequent trial the consumption of fuel for all purposes was carefully ascertained, and this in conjunction with the high propulsive coefficient warrants the belief that on service this vessel will establish new records of efficiency.

After a short period of service it is anticipated that the Owners will authorize the publication of data.

The Toshin Soko

(Continued from page 451).

lbs. capacity, with a speed of 100 feet per minute; one spiral chute; six half-ton hoists; three half-ton stationary hoisting engines, with covered railway siding. There are two rooms on the first and second floors covering 942 *tsubo* specially equipped with ventilators and heating for the storage of bonded silk.

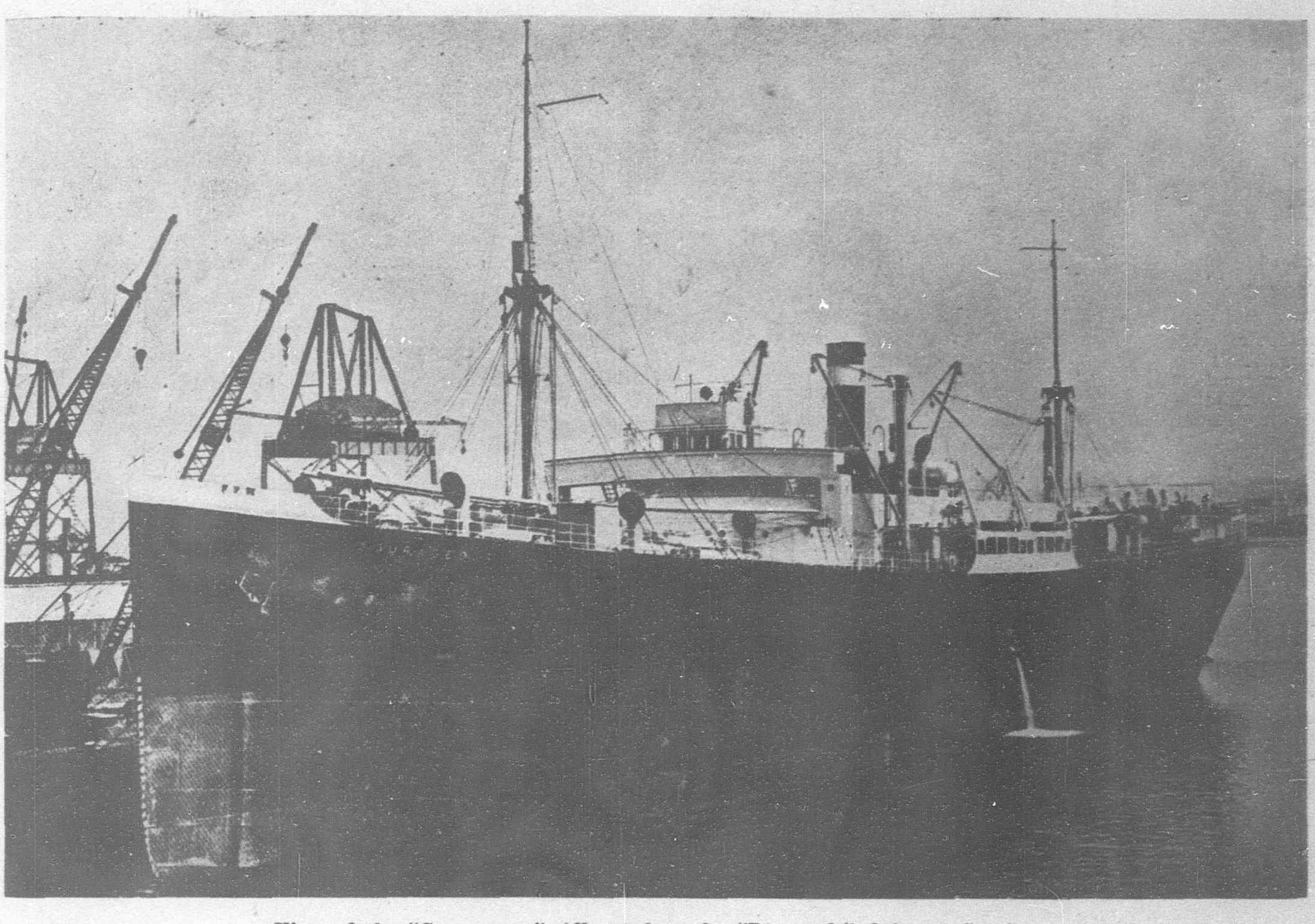
Kobe Warehouse

These magnificent new structures are located within the Customs Compound at Kobe, fronting the extensive wharfage system and connected with the Government railways. The area of the warehouse property is 11,016 sq. yds., the building area, 9,520 sq. yds. and the aggregate floor area, 39,404 sq. yds. Construction was started in March, 1925, and completed in October of the following year. The buildings, of similar design, are of heavy reinforced concrete construction five stories in height including machinery room on the top floor. A feature of these buildings is the heat insulation to keep out the excessive summer heat which prevails in Kobe. The ceiling of the third floor is covered with dolomite and faced with metal lath. Ventilators are also installed.

In addition to the fire hydrants installed on each floor served from a pressure tank on the roof, the Kobe warehouses are equipped with Grinnel automatic sprinklers and automatic fire alarms. The electrical equipment is very complete, all cargo handling devices being motor driven. The mechanical equipment consists of three electric cranes, three goods elevators, each of 8,500 lbs. capacity with a speed of 100 feet per minute; twenty-two half-ton hoists; a number of portable hoisting machines; electric trucks; and a central heating plant. This is located in a separate building in the compound supplying steam to the radiators fitted in the silk and rest rooms. There is also a 1,600 *tsubo* space on the north side of the warehouse specially designed for the storage of silk.

Osaka Warehouse

This new four storey reinforced concrete structure in located at Tomijima-cho and was completed in March, 1927. The warehouse property has an area of about 4,060 sq. yds. building area, 3,192 sq. yds. and an aggregate floor space of 9,792 sq. yds. The height from the ground to the top of tower is 68 feet.



View of the "Courageous" Allocated to the "Roosevelt" Oriental Service

Roosevelts Strengthen New York-Oriental Service

Shipping Board Allocates Additional Motor Vessels of Latest Design to American Pioneer Line

THE U. S. Shipping Board having recognized the coming deficiency of the American Pioneer Line, operating from New York, Norfolk, and Baltimore to the Orient *via* the Panama Canal, allocated in 1929, the newly-converted motor vessels, the *Defiance*, the *Triumph* and the *Courageous* to the Eastern service which is managed under a new lump sum plan by the Roosevelt Steamship Company.

After watching the magnificent operating results of these three powerful motor vessels—an innovation in American Merchant Marine service, the Shipping Board early this year made a further allocation of the motor vessels *Wichita*, *City of Elwood* and the *Jeff Davis* to the Oriental service of the American Pioneer Line, withdrawing these three last ships from the American Pioneer Line's Australian service. It was recognized that America must keep pace with the forward steps being taken by foreign competitors and with the American Pioneer Line serving as a backbone for American shipping in the Oriental trade coming and going direct to the North Atlantic Coast, the Roosevelts sought and were given these veritable giants of the sea.

The conversion and reconditioning of obsolete 9½-knot freighters into modern 14-knot and better Diesel electric craft, which set a new and higher standard for American freight vessels, has cost the U.S. Shipping Board a million and a quarter dollars per vessel. It would have cost many more thousands of dollars for a new ship equal in efficiency and stability to the *Courageous* and *Wichita* type vessels, and as the administration and Congress felt that economy should go hand in hand with our forward steps in building a modern merchant marine, obsolete tonnage should, where consistently possible, be used.

In modernizing these vessels, it was necessary to lengthen their hulls and convert them to a form of propulsion previously untried with freighters of their size. It was recognized that the tendency in modern ocean transportation is towards greater power and speed with bigger and faster freighters competent to maintain timetable schedules.

In *Motor Ship* which heralds the introduction of this radical change in our Merchant Marine program, it was said of these American Pioneer Line vessels that "the conception of Diesel-electric drive, with its smaller, faster-running power units in conjunction with even slower propeller speeds than heretofore . . . . . renders feasible higher powers and higher ship speeds without materially increasing standard Diesel engine sizes. Thus larger cylinders and other parts are avoided."

The credit for the birth of the conversion program must be given to Admiral Wm. S. Benson, then a Commissioner of the Shipping Board, who had the wisdom to see the merits of the Diesel electric plan, the courage to withstand all criticisms and force acceptance of his ideas.

In order that to more easily appreciate the changes made in the vessels the following comparison is given, taking the figures of the vessels' specifications before and after conversion:

	Before Conversion	*After Conversion*
Length—overall	457-ft. 6-in.	468-ft. 6-in.
Length—between perpendiculars ..	440-ft. 1½-in.	457-ft. 4½-in.
Breadth—moulded	56-ft. 0-in.	56-ft. 0-in.
Depth—moulded	38-ft. 0-in.	38-ft. 0-in.
Draft—loaded summer	28-ft. 7½-in.	27-ft. 4-in.
Displacement (loaded)	15,946 tons	15,140 tons
Displacement (light)	4,078 tons	4,640 tons

	Before Conversion	*After Conversion*
Cargo Capacity (grain in holds)	577,992 cu. ft.	577,992 cu. ft.
Cargo Capacity (bales)	579,602 cu. ft.	576,765 cu. ft.
Net cargo capacity (with fully bunkered condition)	9,400 tons	9,128 tons
Bunker capacity (including deep tank in steamer)	2,138 tons	1,159 tons
Fresh water capacity	235 tons	213 tons
Dead-weight capacity (including fuel, water and stores)	11,773 tons	10,500 tons
Machinery weight (including aux. propeller and shafting)	—	928 tons
Power (main engines)	2,645 s.hp.	4,000 s.hp.
Type of machinery	Geared turbines and Scotch boilers	Diesel-electric
Daily fuel-consumption (main and aux. engines at sea)	35 tons	21 tons
Length of passage on full bunkers	13,900 sea miles	17,270 sea miles
Daily fuel consumption (in port)	14 tons	3 tons
Donkey boiler consumption (at sea in winter)	nil	1 ton
Sea speed	9½ knots	13 knots
Propeller speed	80 r.p.m.	60 r.p.m.
Make of engines	General Electric	McIntosh and Seymour
Make of electric equipment	—	General Electric
Length of machinery space	65-ft. 0-in.	65-ft. 0-in.
Length of main Diesel engines	—	32-ft. 0-in.
Weight of each main engine	—	60 tons
No. of men in engine and boiler rooms	17	12

RELATIVE TRANSPORTATION CAPACITY

M. S. Courageous	*At Sea*	*In port*	*Year's Mileage*	*Performance*
Before conversion	210 days*	155 days*	48,000 miles	100 per cent
After conversion	189 days	176 days	59,100 miles	123 per cent

*Assumed basis for comparison.

The *Courageous, Defiance, Triumph* and *City of Elwood* are no longer strangers to the Oriental trade, having already visited several times Japan, China and Philippine ports. A better appreciation of these vessels might be gained if their operating time between certain well-known ports was given. The *Couragous* has made the New York-Manila run, with loading at Norfolk included, in the remarkable time of 37½ days from port to port. All these ships have been in the New York-Orient freight service and have made the passage from Hongkong to New York in 39 days and on one passage, one of the vessels reduced this time by three days, though the agents in the Orient, Messrs. L. Everett, Inc., have prophesied only a passage of from 40 to 42 days.

The *Jeff Davis* and the *Wichita* have never been in this trade, but are sister ships of the *City of Elwood*. These combined passenger and freight vessels become an important adjunct to the American Pioneer service because of their special facilities for carrying valuable commodities. With the appointment of Messrs. L. Everett, Inc. as agents in the Orient for the American Pioneer Line, a berth service for the vessels was inaugurated. With the co-operation of the Far Eastern agents and the Roosevelt Steamship Company as managing operators, and the incalculable assistance of the Shipping Board's officials both at home and in the Orient, the berth service program has been a huge success and the shipping public is daily growing to appreciate the merits of the ships which Congress by its legislation, the Shipping Board by its administration, and the managing operators by their operation, have made available to the public.

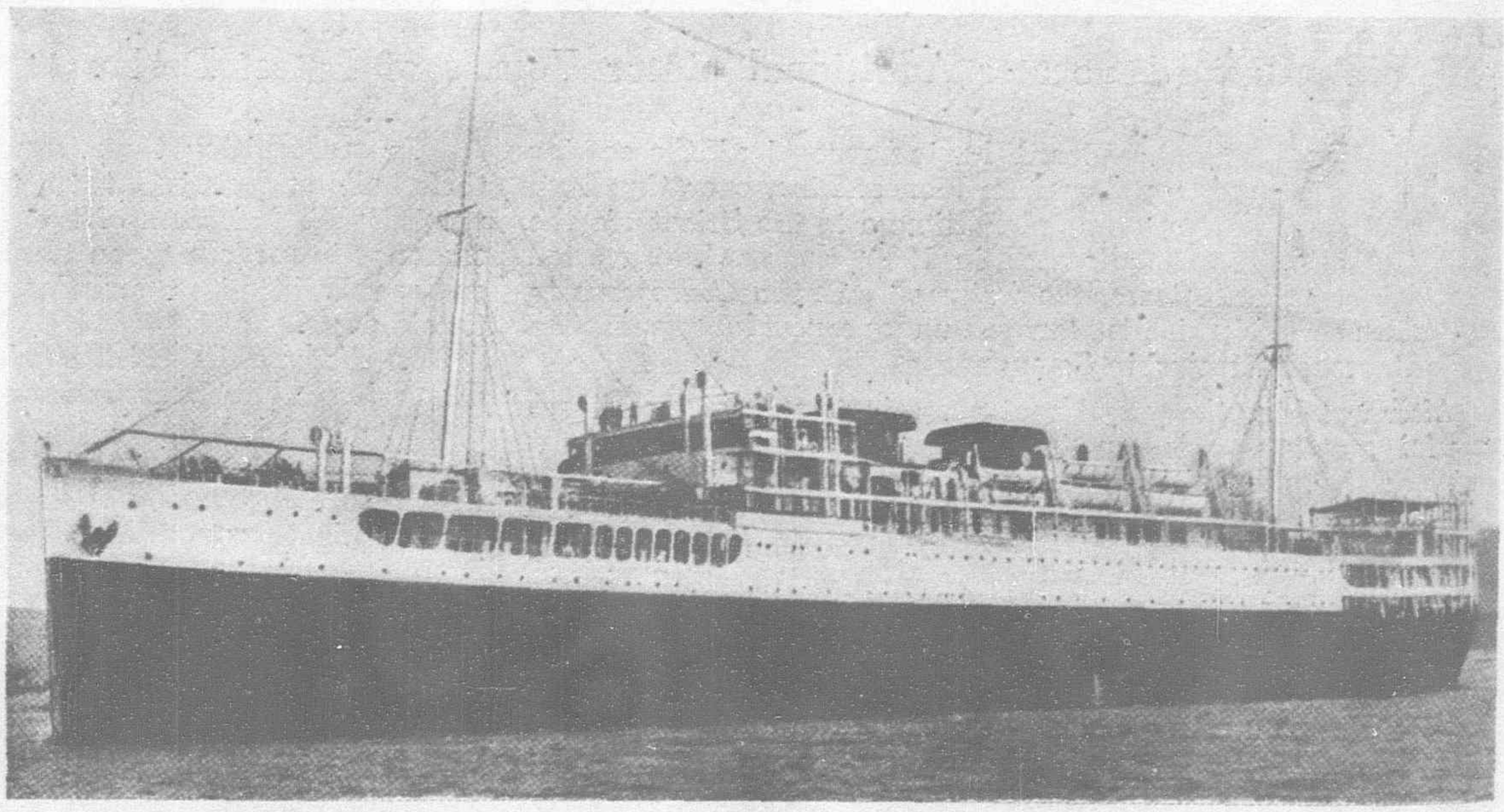
It goes without saying that the time will shortly come when more of these modern cargo carrying lines will supplement the present American Pioneer Service.

M.M. Motorship "Eridan"

IN France, the new motorship *Eridan* of the Messageries Maritimes has run her trials.. The vessel is propelled by two eight-cylinder Sulzer Diesel engines, each developing 3,000 B.H.P. at 110 revs. per min. and built by the Compagnie de Construction Mécanique Procédés Sulzer. The average speed of the M.S. *Eridan* will be 15½ knots. The vessel was built by the Société Provencale de Constructions Navals and is intended for regular passenger and mail service on the Australian line.

The principal dimensions of the ship are :—

Length between perpendiculars	442 ft. 8 in.
Beam	61 ft.
Draught at full load	26 ft. 2 in.
Cargo carrying capacity	3,750 tons



Twin-screw liner *Eridan* of the Messageries Maritimes, Paris, propelled by two eight-cylinder Sulzer Diesel engines developing a total of 6,000 B.H.P. at 110 revs. per min. and constructed by the Compagnie de Construction Mécanique Procédés Sulzer, Paris. The Diesel engine auxiliary plant comprises five Sulzer seven-cylinder airless injection Diesel engines type RKH, with a total output of 1,850 B.H.P. when running at 300 revs. per min., and also two Sulzer compressors, each of 130 B.H.P. at 300 revs. per min. for delivering 300 cub. ft. of air per min. at a pressure of 1,000 lb./sq. in.

The ship has accommodation for 60 first-class passengers, four in state suites, 86 third-class passengers and 436 steerage passengers in cabins with six to 18 berths.

The same firm of shipowners has also placed an order with the Compagnie de Construction Mécanique Procédés Sulzer, Paris, for six two-cycle engines, each developing 5,500 B.H.P. at 110 revs. per min., and fifteen auxiliary engines, each developing 600 B.H.P. at 250 revs. per min., which will be installed in three 22,000-ton passenger ships.

Engineering Notes

INDUSTRIAL

STEEL SHEET-PILING IN JAPAN.—Regarding the much-talked-of project of the Government steelworks at Yawata to produce sheet piles, it is learned that it has been decided to commence their rolling next October. The demand for sheet piles is increasing much in Japan, and it is now met entirely by imports, totalling about 50,000 metric tons per annum, of which 31,000 tons are from Germany, 13,000 tons from the United States, and 6,000 tons from France.

TELEPHONE, TELEGRAPH AND RADIO

MANCHURIAN TELEPHONE SYSTEM.—Plans for the installation of long-distance telephone service connecting the various important cities and districts in the North-eastern provinces, have been approved by the Northeastern Political Affairs Committee.

It is learned that the propose long-distance system will cover a total distance of about 667 miles and the cost of construction is estimated at $4,000,000.

German and American manufacturers are tendering for the contract.

Oriental Contracts Placed in Great Britain

The North British Locomotive Company, Ltd., Glasgow, has secured from the Shanghai-Nanking Railway a contract for eight standard-gauge "Pacific" type locomotives.

Among recent Far Eastern engineering contracts placed in Europe that received by British Insulated Cables, Ltd., Prescot, England, is particularly worthy of note. It is an order for 96,000 yards of underground and subway cable for Shanghai. This firm has recently received a number of important cable orders from abroad, while in Britain it has received the contract to lay the new G.P.O. trunk telephone cable for 42 miles between Manchester and Chester.

The Southern Indian Railway Co. has placed contracts with Siemens Bros. and with the General Electric Co., of London, for power-signalling plant in the Madras electrification scheme. The contract includes the provision and installation of all material for automatic signals, interlocking with color light signals, over a distance of 18 miles, between Madras, Egmore, and Tanbarram. A further contract in connection with the Madras electrification scheme has been placed by the same railway with Callender's Cable & Construction Co., Ltd., London. The value of the order amounts to £6,000. Another order from an Indian railway was received recently by the Hunslet Engine Co., Leeds, which was awarded a contract for ten locomotive bodies by the Nizam's Guaranteed State Railways.

British contractors are interested in the announcement that the Hongkong Government proposes to raise a loan shortly to finance an extensive public works programme. Among the schemes under consideration it is proposed to construct a new reservoir on the south side of the island and to lay a pipeline across the harbor to increase the water supply of the island. A new road is to be constructed to open up the northern half of the new territories.

Several projects now under consideration in Japan are also receiving the attention of British contractors, who are confident that they contain future orders of a substantial nature for their products. One of these is the proposed radio station at Osaka, which is to be built for the purpose of providing a radio telephone service with Shanghai. Another is the new 45,000 kw. hydro-electric plant for which the Yamaguchi Prefectural Electric Bureau has prepared plans involving an expenditure of £800,000. Advices have also been received to the effect that the Oi-gawa Denryoku K.K. is preparing plans for new hydro-electric power stations to be erected on the upper reaches of the Oi River, where it is estimated that 60,000 kw. are available. British electrical exporters will probably submit tenders for the equipment.

Another big shipbuilding order just placed is that of the Anglo-Persian Oil Co., Ltd. for six new oil-carrying vessels totalling approximately 60,000 tons. Together with big contracts for steel works and industrial concerns, these orders will amount approximately to the value of £3,500,000 and provide employment for some thousands of workers for over a year.

The vessels for the company's shipping organization, the British Tanker Co., Ltd., will be employed in carrying various oil products of the Anglo-Persian Oil Co. All six will be motor-driven. Three of the orders have been placed with Palmers Shipbuilding & Iron Co., Ltd., Hebburn-on-Tyne, and are for Doxford-engined ships. The engines for two or three will be built by Doxfords, while those for the third are to be built by Richardson Westgarth & Co. The orders for the three remaining vessels have been placed with builders on the Clyde Lithgows, Ltd., will build two at their Kingston Shipbuilding Yard, Port Glasgow, while the third has been ordered from Greenock Dockyard Co., Ltd., of Greenock. All three vessels are to be fitted with Burmeister & Wain motor engines, to be built by Kincaids, of Greenock.

In addition to these, the Anglo-Persian Oil Co. has been, and is, placing large orders for refinery and oil works equipment, drilling material, tanks, boilers, transport and general engineering material. Included are quantities of pipe line casing from Stewart & Lloyds, of Glasgow; storage tanks from the Motherwell Bridge & Engineering Co.; chemicals from Imperial Chemical Industries; and tinplates from Richard Thomas & Co., South Wales. The transport will include Leyland, Albion, Dennis, Morris, and Karrier motor vehicles. Other big orders have been distributed among concerns in Manchester, Liverpool and the neighborhood.

Improvements contemplated by the Bombay, Baroda, and Central India Railway are expected to bring further big contracts to British engineering firms, as this line is preparing plans for the construction of two new sections aggregating 280 miles in length. A new broad-gauge line is to be laid down between Neemuch and Pachpahar, and this line will be extended to link up at Chhabra with the Great Indian Pacific Railway system. The other proposal is that for a narrow-gauge line from Piplod to Maheshwar, on the Nerbudda River. In connection with the Neemuch-Pachpahar line, it will be necessary to erect a new railway bridge across the Chambal River.